Personal Computer

BASIC User's Manual

Personal Computer

BASIC User's Manual

Notice

Information in this document is subject to change without notice and does not represent a commitment on the part of the Microsoft Corporation. The software described in this document is furnished under a license agreement or non-disclosure agreement. The software may be used or copied only in accordance with the terms of that agreement. It is against the law to copy MS-DOS or GW-BASIC on magnetic tape, disk, or any other medium for any purpose other than the purchaser's personal use.

Copyright (C) Microsoft Corporation, 1983, 1984

Microsoft is a registered trademark, and MS and GW are trademarks of Microsoft Corporation.

IBM is a registered trademark of IBM Corporation.

CONTENTS

CHAPTER 1 INTRODUCTION

1.1 Overview 1-2
1.2 Syntax Notation 1-3
1.3 Resources For Learning BASIC 1-4
1.4 Notice On Language-dependent Characters 1-5

CHAPTER 2 USING THE GW-BASIC 3.1 INTERPRETER

2.1 Invoking BASIC 2-1
2.2 Command Line Option Switches 2-1
2.3 Modes of Operation 2-5
2.4 Line Format 2-6
2.5 Active And Visual (Display) Pages 2-6

CHAPTER 3 LEARNING THE LANGUAGE

3.1 Character Set 3-1
3.1.1 Special Characters 3-2
3.1.2 Control Characters 3-3
3.2 Contents 3-4
3.2.1 String and Numeric Constants 3-4
3.2.2 Single/Double Precision Numeric Constants 3-5
3.3 Variables 3-6
3.3.1 Variable Names and Declaration Characters 3-6
3.3.2 Array Variables 3-9
3.3.3 Space Requirements 3-8
3.4 Expression And Operators 3-9
3.4.1 Precedence of Operations 3-9
3.4.2 Arithmetic Operators 3-10
3.4.3 Integer Division and Modulus Arithmetic 3-11
3.4.4 Overflow and Division by Zero 3-12
3.4.5 Relational Operators 3-12
3.4.6 Logical Operators 3-13
3.4.7 String Operators 3-16
3.5 Type Conversion 3-17
3.6 Functions 3-19
3.6.1 Intrinsic Functions 3-19
3.6.2 User-Defined Functions 3-19

CHAPTER 4 WRITING PROGRAMS USING THE GW-BASIC EDITOR

4.1 EDIT Command 4-1
4.2 Full Screen Editor 4-1
4.2.1 Writing Programs 4-1
4.2.2 Editing Programs 4-4
4.2.3 Control Characters 4-4
4.2.4 Logical Line Definition with INPUT 4-6
4.2.5 Editing Lines with Syntax Errors 4-6

CHAPTER 5 WORKING WITH FILES AND DEVICES

5.1 Default Device 5-1
5.2 Device-Independent Input/Output 5-1
5.3 Filenames And Paths 5-2
5.3.1 Filename Specifications 5-2
5.3.2 Pathnames 5.3
5.3.3 Working With Pathnames in BASIC 5-5
5.4 Re-direction Of Standard Input And Standard Output 5-6
5.5 Handling Files 5-8
5.5.1 Program File Commands 5-8
5.5.2 Protecting Program Files 5-9
5.6 Data Files: Sequential And Random Access I/O 5-10
5.6.1 Sequential File 5-10
5.6.2 Creating a Sequential Files 5-10
5.6.3 Reading Data From a Sequential File 5-12
5.6.4 Adding Data to a Sequential File 5-13
5.6.5 Random Access Files 5-14
5.6.6 Creating a Random Access File 5-15
5.6.7 Accessing a Random Access File 5-16
5.6.8 Random File Operations 5-18
5.7 BASIC And Child Processes 5-21

CHAPTER 6 USING ADVANCED FEATURES

6.1 Assembly Language Subroutines 6-1
6.1.1 Memory Allocation 6-1
6.1.2 Internal Representation 6-2
6.1.3 CALL Statement 6-2
6.1.4 USR Function 6-7
6.2 Event Trapping 6-10
6.2.1 ON GOSUB Statement 6-12
6.2.2 RETURN Statement 6-12

CHAPTER 7 BASIC COMMANDS, FUNCTIONS AND STATEMENTS

ABS Function 7-1
ASC Function 7-2
ATN Function 7-3
AUTO Command 7-4
BEEP Statement 7-5
BLOAD Command 7-6
BSAVE Command 7-8
CALL and CALLS Statements 7-10
CDBL Function 7-11
CHAIN Statement 7-12
CHDIR Statement 7-16
CHR$ Function 7-18
CINT Function 7-19
CIRCLE Statement 7-20
CLEAR Statement 7-23
CLOSE Statement 7-24
CLS Statement 7-25
COLOR Statement (Text mode) 7-26
COLOR Statement (Graphic mode) 7-29
COM Statement 7-31
COMMON Statement 7-32
CONT Command 7-33
COS Function 7-34
CSNG Function 7-35
CSRLIN Function 7-36
CVI, CVS, CVD Functions 7-37
DATA Statement 7-38
DATE$ Statement 7-39
DATE$ Function 7-40
DEF FN Statement 7-41
DEFINT/SNG/DBL/STR Statements 7-43
DEF SEG Statement 7-45
DEF USR Statement 7-46
DELETE Command 7-47
DIM Statement 7-48
DRAW Statement 7-49
EDIT Command 7-53
END Statement 7-54
ENVIRON Statement 7-55
ENVIRON$ Function 7-57
EOF Function 7-58

ERASE Statement 7-59
ERDEV,ERDEV$ Functions 7-60
ERR And ERL Functions 7-61
ERROR Statement 7-62
EXP Function 7-64
FIELD Statement 7-65
FILES Statement 7-68
FIX Function 7-70
FOR...NEXT Statement 7-71
FRE Function 7-74
GET Statement (File I/O) 7-75
GET Statement (Graphics) 7-76
GOSUB...RETURN Statements 7-78
GOTO Statement 7-80
HEX$ Function 7-81
IF...THEN[...ELSE]/IF...GOTO Statements 7-82
INKEY$ Function 7-85
INP Function 7-86
INPUT Statement 7-87
INPUT # Statement 7-89
INPUT$ Function 7-90
INSTR Function 7-91
INT Function 7-92
IOCTL Statement 7-93
IOCTL$ Function 7-94
KEY Statement 7-95
KEY(n) Statement 7-97
KILL Statement 7-100
LEFT$ Function 7-102
LEN Function 7-103
LET Statement 7-104
LINE Statement 7-105
LINE INPUT Statement 7-108
LINE INPUT # Statement 7-109
LIST Command 7-111
LLIST Command 7-113
LOAD Command 7-114
LOC Function 7-115
LOCATE Statement 7-116
LOCK...UNLOCK Statements 7-118
LOF Function 7-121
LOG Function 7-122
LPOS Function 7-123
LPRINT And LPRINT USING Statements 7-124
LSET And RSET Statements 7-125

MERGE Command 7-126
MID$ Statement 7-127
MID$ Function 7-128
MKDIR Statement 7-129
MKI$, MKS$,MKD$ Functions 7-131
NAME Statement 7-132
NEW Command 7-133
OCT$ Function 7-134
ON COM Statement 7-135
ON ERROR GOTO Statement 7-137
ON...GOSUB And ON...GOTO Statements 7-138
ON KEY Statement 7-139
ON PEN Statement 7-144
ON PLAY Statement 7-146
ON STRIG Statement 7-148
ON TIMER Statement 7-150
OPEN Statement 7-152
OPEN COM Statement 7-157
OPTION BASE Statement 7-160
OUT Statement 7-161
PAINT Statement 7-162
PEEK Function 7-165
PEN ON, PEN OFF, PEN STOP Statements 7-166
PEN Function 7-167
PLAY Statement 7-169
PLAY Function 7-173
PLAY ON, PLAY OFF, PLAY STOP Statements 7-174
PMAP Function 7-175
POINT Function 7-177
POKE Statement 7-179
POS Function 7-180
PRESET Statement 7-181
PRINT Statement 7-183
PRINT USING Statement 7-186
PRINT # And PRINT # USING Statements 7-191
PSET Statement 7-194
PUT Statement (File I/O) 7-196
PUT Statement (Graphics) 7-197
RANDOMIZE Statement 7-201
READ Statement 7-203
REM Statement 7-205
RENUM Command 7-207
RESET Command 7-209
RESTORE Statement 7-210
RESUME Statement 7-211

RETURN Statement 7-212
RIGHT$ Function 7-213
RMDIR Statement 7-214
RND Function 7-216
RUN Statement/Command 7-217
SAVE Command 7-218
SCREEN Statement 7-219
SCREEN Function 7-221
SGN Function 7-222
SHELL Statement 7-223
SIN Function 7-225
SOUND Statement 7-226
SPACE$ Function 7-228
SPC Function 7-229
SQR Function 7-230
STICK Function 7-231
STOP Statement 7-232
STR$ Function 7-233
STRIG Function 7-234
STRIG ON, STRIG OFF, STRIG STOP Statements 7-235
STRING$ Function 7-236
SWAP Statement 7-237
SYSTEM Command 7-238
TAB Function 7-239
TAN Function 7-240
TIME$ Statement 7-241
TIME$ Function 7-242
TIMER Function 7-243
TIMER ON, TIMER OFF, TIMER STOP Statements 7-244
TRON/TROFF Statements/Commands 7-245
USR Function 7-246
VAL Function 7-247
VARPTR Function 7-248
VARPTR$ Function 7-250
VIEW Statement 7-252
VIEW PRINT Statement 7-255
WAIT Statement 7-256
WHILE...WEND Statements 7-257
WIDTH Statement 7-258
WINDOW Statement 7-260
WRITE Statement 7-263
WRITE # Statement 7-264

APPENDICES

APPENDIX A ERROR CODES AND ERROR MESSAGES A-1
APPENDIX B MICROSOFT GW-BASIC RESERVED WORDS.....B-1
APPENDIX C MATHEMATICAL FUNCTIONS NOT INTRINSIC TO GW-BASIC 3.1.....C-1
APPENDIX D CHARACTER CODE TABLE D-1

CHAPTER 1
INTRODUCTION

Microsoft Corporation wrote the first BASIC interpreter for microcomputers in 1975. Today Microsoft BASIC has more than one million installations and is used in a wide range of operating environments. Indeed, as Microsoft claims, BASIC is the language spoken by 9 out of 10 microcomputers in the world today. Many users, manufacturers, and software developers have written application programs in Microsoft® BASIC.

The BASIC interpreter is a general-purpose programming language that has proven to be highly effective for many uses, including business, scientific, games, and educational applications.

Microsoft GW™-BASIC Version 3.1 is the most extensive implementation of Microsoft BASIC currently available for microcomputers. Fully meeting the requirements of the ANSI subset standard for BASIC, it supports many features that are not found in other BASIC interpreters. In addition, Microsoft GW-BASIC Version 3.1 boasts sophisticated screen handling, graphics, and structured programming features that make it especially suited for the development of application programs.

1.1 Overview

GW-BASIC Version 3.1 includes several features not found in other implementations of BASIC. It has been expressly designed to take advantage of the MS™-DOS Version 3.1 environment to enhance programming power.

The new features and improvements over GW-BASIC Version 1.0 include the following:

- Redirection of standard input (LINE, LINE INPUT) and standard output (PRINT).
- Character Device support that permits BASIC to initialize and communicate with user-installed devices.
- Enhanced disk I/O facilities for easier handling of larger files.
- SHELL for running COMMAND or Child without leaving BASIC.
- Multi-level directories for improved disk organization.
- Directory management (MKDIR/CHDIR/RMDIR).
- Improved graphics featuring line clipping as well as the VIEW and WINDOW commands.
- Screen Editor enhancements including text window support.
- Error reporting with greater precision due to the new ERDEV and ERDEV$ system functions.
- PLAY and TIMER commands for additional event trapping.
- User-definable keyboard trapping.
- Double-precision transcendentals (on demand with the /D switch).
- More efficient control of BASIC's memory allocation with the /M switch.

1.2 Syntax Notation

When commands are discussed in this document, the following notation will be followed:

[ ] Square brackets indicate that the enclosed entry is optional.

< > Angle brackets indicate user-entered data. When the angle brackets enclose lowercase text, the user must type in an entry defined by the text; for example, <*filename*>. When the angle brackets enclose uppercase text, the user must press the key named by the text; for example, <ENTER>.

{ } Braces indicate that the user has a choice between two or more entries. At least one of the entries enclosed in braces must be chosen unless the entries are also enclosed in square brackets.

| Vertical bars separate choices within braces. At least one of the entries separated by bars must be chosen unless the entries are also enclosed in square brackets.

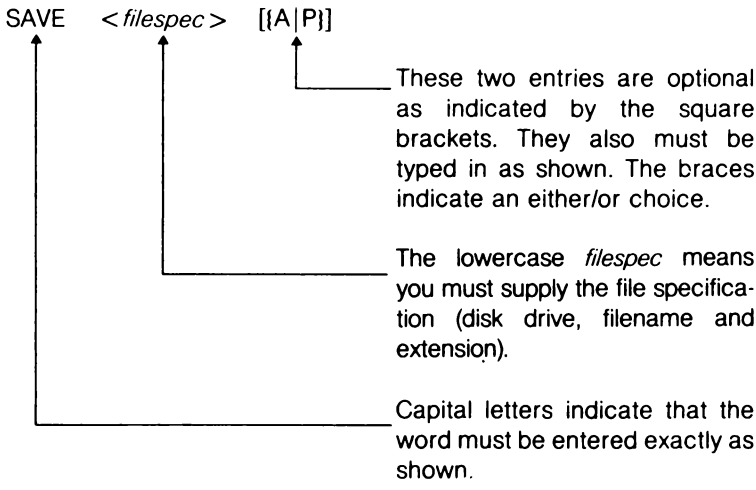
... Ellipses indicate that an entry may be repeated as many times as needed or desired.

CAPS Capital letters indicate portions of statements or commands that must be entered exactly as shown.

All other punctuation, such as commas, colons, slash marks, and equal signs, must be entered exactly as shown.

Examples

Command Line Explanation


SAVE <filespec> [{A|P}]
These two entries are optional as indicated by the square brackets. They also must be typed in as shown. The braces indicate an either/or choice.
The lowercase filespec means you must supply the file specification (disk drive, filename and extension).
Capital letters indicate that the word must be entered exactly as shown.

1.3 Resources For Learning BASIC

This manual provides complete instructions for using Microsoft BASIC. However, no training material for BASIC programming has been provided. If you are new to BASIC or need help in learning programming, we suggest you read one of the following:

Dwyer, Thomas A. and Critchfield, Margot. *BASIC and the Personal Computer*. Reading, Mass.: Addison-Wesley Publishing Co., 1978.

Albrecht, Robert L., Finkel, LeRoy, and Brown, Jerry. *BASIC*. New York: Wiley Interscience, 2nd ed., 1978.

Billings, Karen and Moursund, David. *Are You Computer Literate?* Beaverton, Oregon: Dilithium Press, 1979.

Coan, James. *Basic BASIC*. Rochelle Park, N.J.: Hayden Book Company, 1978.

1.4 Notes on Language-dependent Characters

BASIC is designed for use of ASCII (American Standard Code for Information Interchange) characters. BASIC will use many special characters which include language-dependent character position of code table.

So, BASIC may display strange characters as a substitute of which is described in this manual.

The language-dependent characters which are used in BASIC are described below.

#	Specifies double precision real number Specifies the file number Specifies a format in PRINT USING statements
[ ]	Indicates the line number when tracking Used as a substitute for ( ) parenthesizing subscript
\	Integer division operator Specifies a format in PRINT USING statements Specifies a pathname
^	Exponentiation operator Specifies a format in PRINT USING statements
|	Specifies pipe function in DOS commands

This manual is written in ASCII character basis.

CHAPTER 2

USING THE GW-BASIC 3.1 INTERPRETER

2.1 Invoking BASIC

To begin operating the GW-BASIC Interpreter, load the MS-DOS operating system referring to the separate Owner's Manual and then enter following in response to the prompt A>:

```
BASICA
```

To begin operating a specific program as soon as BASIC has started, load the operating system and enter:

```
BASICA <filespec>
```

where *<filespec>* is a filename preceded by an optional device designator, and followed by an optional extension name.

For example, to start the program FILE.BAS which is on disk drive A:, enter:

```
BASICA A:FILE.BAS
```

2.2 Command Line Option Switches

The BASIC operating environment may be altered somewhat by specifying option switches following BASIC on the command line. The format of BASIC's command line is:

BASICA [*<stdin*]
[*>stdout*]
[*<filespec>*]
[/C:*<buffer size>*]
[/D]
[/F:*<number of files>*]
[/M:[*<highest memory location>*][,*<maximum block size>*]]
[/S:*<recl>*]

WHERE:

< stdin

BASIC input is redirected from the file specified by *stdin*. When present, this syntax must appear before any switches. Note that the less-than character "<" is literally that character, and not an angle bracket indicating a required argument.

> stdout

BASIC output is redirected to the file specified by *stdout*. When present, this syntax must appear before any switches. If two greater-than signs appear (">>"), the output is appended to an existing output file. If an existing file is to be written to, this is the way to prevent that file from being overwritten. Note that the greater-than character ">" is literally that character, and not an angle bracket indicating a required argument.

< filespec >

This is the file specification of a BASIC program. If *< filespec >* is present, BASIC proceeds as if a RUN *< filespec >* command were given after initialization is complete. This allows BASIC programs to be initiated by a batch file by putting this form of the command line in an AUTOEXEC.BAT file. Programs run in this manner will need to exit via the SYSTEM statement in order to allow the next command from the AUTOEXEC.BAT file to be executed. *< filespec >* need not to be enclosed with double quotation marks.

/F:< number of files >

If this switch is present, the maximum number of files that may be open simultaneously during the execution of a BASIC program is set to *< number of files >*. Each file requires 62 bytes for the File Control Block (FCB) plus 128 bytes for the data buffer. The data buffer size may bc altered via the /S: option switch. If the /F: option is omitted, the number of files is set to 3.

The number of open files that MS-DOS supports depends upon the value of the FILES= parameter in the CONFIG.SYS file. It is recommended that FILES = 10 for BASIC. Keep in mind that the first 3 are taken by Stdin, Stdout, Stderr, Stdaux, and Stdprn. One additional handle is needed by BASIC for LOAD, SAVE, CHAIN, NAME, and MERGE. This leaves 6 for BASIC File I/O, thus /F:6 is the maximum supported by MS-DOS when FILES = 10 appears in the CONFIG.SYS file.

Attempting to OPEN a file after all the file handles have been exhausted will result in a "Too many files" error.

/S:<*lrecl*>

If this switch is present, then the maximum record size allowed for use with random files is set to <*lrecl*>. NOTE: the record size option to the OPEN statement cannot exceed this value. If the /S: option is omitted, the record size defaults to 128 bytes.

/C:<*buffer size*>

If present, this switch controls RS-232C Communications. /C:0 disables RS-232C support. Any subsequent I/O attempts will result in a "Device Unavailable" error. Specifying /C:<*n*> allocates space for communications buffers. The amount of space allocated is dependent on the machine-specific portion of GW-BASIC.

/D

If present, this switch causes the Double Precision Transcendental math package to remain resident. If omitted, this package is discarded and the space is freed for program use.

/M: [<*highest memory location*>] [,<*max block size*>]

When present, this switch sets the highest memory location that will be used by BASIC. BASIC will attempt to allocate 64k of memory for the data and stack segment. If machine language subroutines are to be used with BASIC programs, use the /M: switch to set the highest location that BASIC can use. When omitted or 0, BASIC attempts to allocate all it can up to a maximum of 65536 bytes.

If you intend to load things above the highest location that BASIC can use, then use the optional parameter <*maximum block size*> to preserve space for them. This is necessary if you intend to use the SHELL statement. Failure to do so will result in COMMAND being loaded on top of your routines when a SHELL statement is executed.

<*maximum block size*> must be in paragraphs (byte multiples of 16). When omitted, &H1000 (4096) is assumed. This allocates 65536 bytes (65536 = 4096 x 16) for BASIC's data and stack segment. For example, if you wanted 65536 bytes for BASIC and 512 bytes for machine language subroutines, then use /M:,&H1010 (4096 paragraphs for BASIC + 16 paragraphs for your routines).

This option can also be used to shrink the BASIC block in order to free more memory for shelling other programs. /M:,2048 allocates 32768 bytes for data and stack. /M:32000,2048 allocates 32768 bytes maximum, but BASIC will only use the lower 32000. This leaves 768 bytes for the user.

NOTE:

<number of files>, *<lrecl>*, *<buffer size>*, *<highest memory location>*, and *<maximum block size>* are numbers that may be decimal, octal (preceded by &O), or hexadecimal (preceded by &H).

Example: A>BASICA PAYROLL

Use 64k of memory and 3 files, load and execute PAYROLL.BAS.

A>BASICA INVENT/F:6

Use 64k of memory and 6 files, load and execute INVENT.BAS.

A>BASICA /C:0/M:32768

Disable RS-232C support and use only the first 32k of memory. The memory above that is free for the user.

A>BASICA /F:4/S:512

Use 4 files and allow a maximum record length of 512 bytes.

A>BASICA TTY/C:512

Use 64k of memory and 3 files. Allocate 512 bytes to RS-232C receive buffers and 128 bytes to transmit buffers, load and execute TTY.BAS.

2.3 Modes Of Operation

The Microsoft GW-BASIC Interpreter may be used in either of two modes: direct mode or indirect mode.

In direct mode, statements and commands are executed as they are entered. They are not preceded by line numbers. After each direct statement followed by a carriage return, the screen will display the "Ok" prompt. Results of arithmetic and logical operations may be displayed immediately and stored for later use, but the instructions themselves are lost after execution. Direct mode is useful for debugging and for using the GW-BASIC Interpreter as a calculator for quick computations that do not require a complete program.

Indirect mode is used for entering programs. Program lines are preceded by line numbers and may later be stored in memory. The program stored in memory is executed by entering the RUN command.

2.4 Line Format

Microsoft GW-BASIC program lines have the following format (square brackets indicate optional input):

<nnnnn> <BASIC statement>[*:BASIC statement...*] *<carriage return>*

More than one GW-BASIC statement may be placed on a line, but each must be separated from the last by a colon.

A Microsoft GW-BASIC program line always begins with a line number and ends with a carriage return. Line numbers indicate the order in which the program lines are stored in memory. Line numbers are also used as references in branching and editing. Line numbers must be in the range 0 to 65529.

A line may contain a maximum of 255 characters.

With the interpreter, you can extend a logical line over more than one physical line by entering a *<linefeed>*. *<linefeed>* lets you continue typing a logical line on the next physical line without entering a *<carriage return>*. Alternatively, you may type up to 255 characters on a logical line without issuing either a line feed or a carriage return; the text is wrapped and continues on the next physical line.

A period (.) may be used in EDIT, LIST, AUTO, and DELETE commands to refer to the current line.

2.5 Active And Visual (Display) Pages

The size of these pages is set by the SCREEN statement. (See SCREEN Statement.)

CHAPTER 3

LEARNING THE LANGUAGE

Like any language, BASIC has an alphabet and common phrases. This chapter presents the BASIC character set, and the rules for the constants, variables, and expressions that the programming language uses.

3.1 CHARACTER SET

The Microsoft GW-BASIC character set consists of alphabetic characters, numeric characters, and special characters.

The alphabetic characters in GW-BASIC are the uppercase and lowercase letters of the English alphabet.

The GW-BASIC numeric characters are the digits 0 through 9. The alphabetic characters A,B,C,D,E, and F may be used as part of hexadecimal numbers.

3.1.1 Special Characters

The following special characters and terminal keys are recognized by GW-BASIC:

Character	Action
	Blank
=	Equals sign or assignment symbol
+	Plus sign
–	Minus sign
*	Asterisk or multiplication symbol
/	Slash or division symbol
^	Up arrow or exponentiation symbol
(	Left parenthesis
)	Right parenthesis
%	Percent or integer type declaration character
#	Number (or pound) sign or double precision type declaration character
$	Dollar sign or string type declaration character
!	Exclamation point or single precision type declaration character
[	Left bracket
]	Right bracket
,	Comma
.	Period or decimal point
'	Single quotation mark (apostrophe)
;	Semicolon
:	Colon
&	Ampersand
?	Question mark or substitution of PRINT
<	Less than
>	Greater than
\	Backslash or integer division symbol
@	At sign
_	Underscore
'	Single quotation or remark delimiter
"	Double quotation or string delimiter
<BS>	Deletes last character typed.
<escape>	Escapes edit mode subcommands.
<tab>	Moves print position to next tab stop. Tab stops are set every eight columns.
<linefeed>	Moves to next physical line.
<ENTER>	Terminates input of a line.

3.1.2 Control Characters

Microsoft GW-BASIC supports the following control characters:

Control Character	Action	Equivalent
Control-B	Moves cursor to previous word.	Control- ←
Control-C	With the interpreter, interrupts program execution and returns to BASIC command level.	Control-Scroll Lock
Control-E	Clears to end of line	Control-End
Control-F	Moves cursor to the next word.	Control- →
Control-G	Sounds the speaker.	
Control-H	Backspaces. Deletes the last character typed.	BS
Control-I	Tabs to the next tab stop. Tab stops are set every eight columns.	Tab
Control-J	Line-feed	
Control-K	Sends cursor to home location.	Home
Control-L	Clears the screen.	Control-Home
Control-M	Carriage return	ENTER
Control-N	Moves cursor to the end of the line.	
Control-R	Toggles the insert and typeover modes.	Ins

3.2 Constants

Constants are the values that cannot be changed during execution. There are two types of constants: string and numeric.

3.2.1 String and Numeric Constants

A string constant is a sequence of up to 255 alphanumeric and specified control characters enclosed in double quotation marks.

Examples:

"HELLO"
"$25,000.00"
"Number of Employees"

Numeric constants are positive or negative numbers. Microsoft GW-BASIC numeric constants cannot contain commas. There are five types of numeric constants:

1. Integer constants — Whole numbers between −32768 and 32767. Integer constants do not contain decimal points.

2. Fixed-point constants — Positive or negative real numbers, i.e., numbers that contain decimal points.

3. Floating-point constants — Positive or negative numbers represented in exponential form (similar to scientific notation). A floating-point constant consists of an optionally signed integer or fixed-point number (the mantissa) followed by the letter E and an optionally signed integer (the exponent). The allowable range for floating-point constants is 3.0E-39 to 1.7E + 38.

   Examples:
   235.988E − 7 = .0000235988
   2359E6 = 2359000000

   (Double precision floating-point constants are denoted by the letter D instead of E.)

4 Hex constants — Hexadecimal numbers, denoted by the prefix &H. Hex constants may be no greater than decimal 64K.

Examples:
&H76
&H32F

5 Octal constants — Octal numbers, denoted by the prefix &O or &. Octal constants may not exceed decimal 64K.

Examples:
&O347
&1234

3.2.2 Single/Double Precision Numeric Constants

Numeric constants may be either single precision or double precision numbers. Single precision numeric constants are stored with 7 digits of precision and printed with up to 6 digits of precision. Double precision numeric constants are stored with 16 digits of precision and printed with up to 16 digits.

A single precision constant is any numeric constant that has one of the following characteristics:

1. Seven or fewer digits
2. Exponential form using E
3. A trailing exclamation point (!)

Examples:
46.8
−1.09E−06
3489.0
22.5!

A double precision constant is any numeric constant that has one of these characteristics:

1. Eight or more digits
2. Exponential form using D
3. A trailing number sign (#)

Examples:

345692811
−1.09432D−06
3489.0#
7654321.1234

3.3 Variables

Variables are names used to represent values used in a GW-BASIC program. The value of a variable may be assigned explicitly by the programmer, or it may be assigned as the result of calculations in the program. Before a variable is assigned a value, its value is assumed to be zero (or null for a string variable).

3.3.1 Variable Names and Declaration Characters

Microsoft GW-BASIC variable names may be any length. Up to 40 characters are significant. Variable names can contain letters, numbers, and the decimal point. However, the first character must be a letter. Special type declaration characters (listed below) are also allowed.

A variable name may not be a reserved word, but embedded reserved words are allowed, with one exception: no variable may start with the letters USR. For example, the variable USRNAM$ will generate a syntax error. Reserved words include all Microsoft GW-BASIC commands, statements, function names, and operator names. If a variable begins with FN, it is assumed to be a call to a user-defined function.

Variables may represent either a numeric value or a string. String variable names are written with a dollar sign ($) as the last character. For example: A$ = "SALES REPORT". The dollar sign is a variable type declaration character; that is, it "declares" that the variable will represent a string.

Numeric variable names may be declared as integer, single precision, or double precision values. The type declaration characters for these variable names are as follows:

%	Integer variable
!	Single precision variable
#	Double precision variable

The default type for a variable name is single precision. However, if a number specified in a program has too many significant digits to be represented by a single precision number, it will be represented as a double precision number, and the " " which signifies double precision will follow the number in the program listing.

Integer variables produce the fastest and most compact object code. For example, the following program executes approximately 30 times faster when the loop control variable "I" is replaced with "I%", or when I is declared an integer variable with DEFINT.

```
100 FOR I=1 TO 10
120 A(I)=0
140 NEXT I
```

Examples of Microsoft GW-BASIC variable names:

PI#	Declares a double precision value.
MINIMUM!	Declares a single precision value.
LIMIT%	Declares an integer value.
N$	Declares a string value.
ABC	Represents a single precision value.

The default variable type may be selectively changed by using the GW-BASIC statements DEFINT, DEFSTR, DEFDBL, and DEFSNG. These statements are described in detail in Chapter 7.

3.3.2 Array Variables

An array is a group or table of values referenced by the same variable name. Each element in an array is referenced by an array variable that is subscripted with an integer or an integer expression. An array variable name has as many subscripts as there are dimensions in the array. For example V(10) would reference a value in a one-dimension array, T(1,4) would reference a value in a two-dimension array, and so on. The maximum number of dimensions for an array is 255. The maximum number of elements per dimension is 32,767. The maximum amount of space that may be taken for an array is less than the number of bytes in memory that are not being used.

3.3.3 Space Requirements

The following list gives only the number of bytes occupied by the values represented by the variable names.

Variables	**Type**	**Bytes**
	Integer	2
	Single precision	4
	Double precision	8
	String	3

Arrays	**Type**	**Bytes**
	Integer	2 per element
	Single precision	4 per element
	Double precision	8 per element
	String	3 per element

3.4 Expressions And Operators

An expression may be a string or numeric constant, a variable, or a combination of constants and variables with operators. An expression always produces a single value.

Operators perform mathematical or logical operations on values. GW-BASIC operators may be divided into three categories:

1. Arithmetic
2. Relational
3. Logical

Each category is described in the following sections.

3.4.1 Precedence of Operations

The GW-BASIC operators have an order of precedence; that is, when several operations take place within the same program statement, certain kinds of operations will be performed before others. If the operations are of the same level of precedence, the first to be executed will be the leftmost, and the last, the rightmost. The following is the order in which operations are executed.

1. Exponentiation
2. Negation
3. Multiplication & Division
4. Integer Division
5. Modulus Arithmetic
6. Addition & Subtraction
7. Relational Operators
8. NOT
9. AND
10. OR & XOR
11. EQV
12. IMP

3.4.2 Arithmetic Operators

The arithmetic operators, in order of evaluation, are:

Operator	Operation	Sample Expression
^	Exponentiation	X^Y
–	Negation	–X
*, /	Multiplication, Floating-point Division	X*Y X/Y
\	Integer Division	12\5 = 2
MOD	Modulus Arithmetic	10 MOD 3 = 1 (10/3 = 3 with remainder 1)
+, –	Addition, Subtraction	X + Y

You can change the order of evaluation by using parentheses. Operations within parentheses are performed first. Inside parentheses, the usual order of operations is maintained.

The following list gives some sample algebraic expressions and their Microsoft GW-BASIC counterparts.

Algebraic expression	Two consecutive operators
$X+2Y$	X+Y*2
$X-\frac{Y}{Z}$	X-Y/Z
$\frac{XY}{Z}$	X*Y/Z
$\frac{X+Y}{Z}$	(X+Y)/Z
$(X^2)^Y$	(X^2)^Y
X^{YZ}	X^(Y^Z)
X(-Y)	X*(-Y) Two consecutive operators must be separated by parentheses.

3.4.3 Integer Division and Modulus Arithmetic

In addition to the six standard operators (addition, subtraction, multiplication, division, negation, and exponentiation), GW-BASIC supports integer division and modulus arithmetic.

Integer division is denoted by the backslash (\ ). The operands are rounded to integers (must be in the range—32768 to 32767) before the division is performed, and the quotient is truncated to an integer.

Examples:

```
100 LET DIV1 = 10\4
200 LET DIV2 = 25.68\6.99
300 PRINT DIV1, DIV2
```

will yield

```
 2        3
```

Modulus arithmetic is denoted by the operator MOD. Modulus arithmetic yields the integer value that is the remainder of an integer division.

Examples:

```
10 PRINT 10.4 MOD 4,25.68 MOD 6.99
```

will yield

```
 2        5
```

because (10/4 = 2) with a remainder 2) and (26/7 = 3 with a remainder 5)

3.4.4 Overflow and Division by Zero

If division by zero is encountered during the evaluation of an expression, a "Division by zero" error message is displayed. Machine infinity (the largest number that can be represented in floating-point format) with the sign of the numerator is supplied as the result of the division, and execution continues. If the evaluation of an exponentiation operator results in zero being raised to a negative power, the "Division by zero" error message is displayed, positive machine infinity is supplied as the result of the exponentiation, and execution continues.

If overflow occurs, the interpreter displays an "Overflow" error message, supplies machine infinity with the algebraically correct sign as the result, and continues execution.

3.4.5 Relational Operators

Relational operators are used to compare two values. The result of the comparison is either "true" (−1) or "false" (0) This result may then be used to make a decision regarding program flow. (See IF Statement in Chapter 7.)

The relational operators are:

Operator	Relation Tested	Example
=	Equality	X = Y
< > or > <	Inequality	X< >Y
<	Less than	X<Y
>	Greater than	X>Y
< = or = <	Less than or equal to	X< =Y
> = or = >	Greater than or equal to	X> =Y

(The equal sign is also used to assign a value to a variable. See the LET statement in Chapter 7.)

When arithmetic and relational operators are combined in one expression, the arithmetic is always performed first. For example, the expression

```
X+Y<(T-1)/Z
```

is true if the value of X plus Y is less than the value of T – 1 divided by Z.

More examples:

```
IF SIN(X)<0 GOTO 1000
IF I MOD J< >0 THEN K=K+1
```

3.4.6 Logical Operators

The logical operator performs bit-by-bit calculation and returns a result which is either "true" (not zero) or "false" (zero). In an expression, logical operations are performed after arithmetic and relational operations. The outcome of a logical operation is determined as shown in Table 3-1. The operators are listed in order of precedence.

Table 3-1. GW-BASIC Relational Operators Truth Table

Operation	Value	Value	Result
NOT			
	X		NOT X
	T		F
	F		T
AND			
	X	Y	X AND Y
	T	T	T
	T	F	F
	F	T	F
	F	F	F
OR			
	X	Y	X OR Y
	T	T	T
	T	F	T
	F	T	T
	F	F	F
XOR			
	X	Y	X XOR Y
	T	T	F
	T	F	T
	F	T	T
	F	F	F
EQV			
	X	Y	X EQV Y
	T	T	T
	T	F	F
	F	T	F
	F	F	T
IMP			
	X	Y	X IMP Y
	T	T	T
	T	F	F
	F	T	T
	F	F	T

Just as the relational operators can be used to make decisions regarding program flow, logical operators can connect two or more relations and return a true or false value to be used in a decision (see IF Statements in Chapter 7.)

Example:

```
IF D<200 AND F<4 THEN 80
IF I>10 OR K<0 THEN 50

IF NOT P THEN 100
```

Logical operators work by converting their operands to 16-bit, signed, two's complement integers in the range −32768 to 32767. (If the operands are not in this range, an error results.) If both operands are supplied as 0 or −1, logical operators return 0 or −1. The given operation is performed on these integers bit-by-bit; i.e., each bit of the result is determined by the corresponding bits in the two operands.

Thus, it is possible to use logical operators to test bytes for a particular bit pattern. For instance, the AND operator may be used to "mask" all but one of the bits of a status byte at a machine I/O port. The OR operator may be used to "merge" two bytes to create a particular binary value. The following examples, all using decimal numbers, demonstrate how the logical operators work.

63 AND 16 = 16	63 = binary 111111 and 16 = binary 10000, so 63 AND 16 = 16.
15 AND 14 = 14	15 = binary 1111 and 14 = binary 1110, so 15 AND 14 = 14 (binary 1110).
−1 AND 8 = 8	−1 = binary 1111111111111111 and 8 = binary 1000, so −1 AND 8 = 8.
4 OR 2 = 6	4 = binary 100 and 2 = binary 10, so 4 OR 2 = 6 (binary 110).

10 OR 10 = 10 — 10 = binary 1010, so 1010 OR 1010 = 1010 (decimal 10).

−1 OR −2 = −1 — −1 = binary 1111111111111111 and −2 = binary 1111111111111110, so −1 OR −2 = −1. The bit complement of sixteen zeros is sixteen ones, which is the two's complement representation of −1.

NOT X = −(X + 1) — The two's complement of any integer is the bit complement plus one.

3.4.7 String Operators

Strings may be concatenated by using the plus sign (+). For example:

```
10 A$ = "FILE": B$ = "NAME"
20 PRINT A$ + B$
30 PRINT "NEW" + A$ + B$
```

will yield

```
FILENAME
NEW FILENAME
```

Strings may be compared using the same relational operators that are used with numbers:

= <> < > <= >=

String comparisons are made by taking one character at a time from each string and comparing the ASCII codes. If all the ASCII codes are the same, the strings are equal. If the ASCII codes differ, the lower code number precedes the higher. If during string comparison the end of one string is reached, the shorter string is said to be smaller. Leading and trailing blanks are significant.

For example:

```
"AA"          is less than      "AB"
"FILENAME"    is equal to       "FILENAME"
"X&"          is greater than   "X#"
        (because # comes before &)
"CL "         is greater than   "CL"
        (because of the trailing space)
"kg"          is greater than   "KG"
"SMYTH"       is less than      "SMYTHE"
B$            is less than      "9/12/78"
        (where B$ = "8/12/78")
```

Thus, string comparisons can be used to test string values or to alphabetize strings. All string constants used in comparison expressions must be enclosed in quotation marks.

3.5 Type Conversion

When necessary, Microsoft GW-BASIC will convert a numeric constant from one type to another. The following rules and examples apply to conversions.

1. If a numeric variable of one type is set equal to a numeric constant of a different type, the number will be stored as the type declared in the variable name.

   Example:

   ```
   10 PERCENT% = 23.42
   20 PRINT PERCENT%
   ```

   will yield

   ```
   23
   ```

2. During expression evaluation, all of the operands in an arithmetic or relational operation are converted to the same degree of precision as that of the most precise operand. Also, the result of an arithmetic operation is returned to this degree of precision.

Examples:

```
10 DEDUCTION# = 6#/7
20 PRINT DEDUCTION#
```

will yield

```
.8571428571428571
```

The arithmetic was performed in double precision and the result was returned in DEDUCTION# as a double precision value.

```
10 DEDUCTION = 6#/7
20 PRINT DEDUCTION
```

will yield

```
.857143
```

The arithmetic was performed in double precision, and the result is rounded to single precision and returned to DEDUCTION (single precision variable), and printed.

3. Logical operators (see Section 3.4.6) convert their operands to integers and return an integer result. Operands must be in the range −32768 to 32767 or an "Overflow" error occurs.

4. When a floating-point value is converted to an integer, the fractional portion is rounded.

   Example:

```
10 CASH% = 55.88
20 PRINT CASH%
```

   will yield

```
56
```

5. If a double precision variable is assigned a single precision value, only the first seven digits (rounded) of the converted number will be valid. This is because only seven digits of accuracy were supplied with the single precision value. The absolute value of the difference between the printed double precision number and the original single precision value will be less than 6.3E-8 times the original single precision value.

   Example:

```
10 A = 2.04
20 B# = A
30 PRINT A;B#
```

   will yield

```
2.04 2.039999961853027
```


3.6 Functions

GW-BASIC 3.1 incorporates two kinds of functions: intrinsic and user-defined.

3.6.1 Intrinsic Functions

When a function is used in an expression, it calls a predetermined operation that is to be performed on an operand. Microsoft GW-BASIC has functional operators that reside in the system, such as SQR (square root) or SIN (sine), and these resident functions are called "intrinsic functions".

3.6.2 User-Defined Functions

Microsoft GW-BASIC also allows "user-defined" functions that are written by the programmer. See DEF FN Statement in Chapter 7.

CHAPTER 4

WRITING PROGRAMS USING THE GW-BASIC EDITOR

GW-BASIC provides two ways to enter and edit text: you can issue an EDIT command to place you in edit mode or use the full screen editor.

4.1 EDIT Command

The EDIT command places the cursor on a specified line so that changes can be made to the line. See EDIT command in Chapter 7.

4.2 Full Screen Editor

The full screen editor gives you immediate visual feedback, so that program text is entered in a "what you see is what you get" manner. If the user has a program listing on the screen, the cursor can be moved to a program line, the line edited, and the change entered by pressing the return key. This time-saving capability is made possible by special keys for cursor movement, character insertion and deletion, and line or screen erasure. Specific functions and key assignments are discussed in the following sections.

With the full screen editor, you can move quickly around the screen, making corrections where necessary. The changes are entered by placing the cursor on the changed line and pressing <ENTER>.

When input processes are directed from the screen, the user may use the full-screen editor features in responding to INPUT and LINE INPUT statements.

4.2.1 Writing Programs

You are using the full screen editor any time between the interpreter's "Ok" prompt and the execution of a RUN command. Any line of text that is entered is processed by the editor. Any line of text that begins with a number is considered a program statement.

It is possible to extend a logical line over more than one physical line by continuing typing beyond the last column of the screen. The editor wraps the logical line so that it continues on the next physical line. A carriage return signals the end of the logical line; when a carriage return is entered, the entire logical line is passed to GW-BASIC. Up to 255 characters may be present in one logical line.

Program statements are processed by the editor in one of the following ways:

1. A new line is added to the program. This occurs if the line number is valid (0 through 65529) and at least one non-blank character follows the line number.

2. An existing line is modified. This occurs if the line number matches that of an existing line in the program. The existing line is replaced with the text of the new line.

3. An existing line is deleted. This occurs if the line contains only the line number, and the number matches that of an existing line.

4. The statements are passed to the command scanner for interpretation (i.e., the statement is executed).

5. An error is produced.

   If an attempt is made to delete a non-existent line, an "Undefined line" error message is displayed.

   If program memory is exhausted, and a line is added to the program, an "Out of memory" error message is displayed, and the line is not added.

More than one statement may be placed on a line. If this is done, the statements must be separated by a colon (:). The colon need not be surrounded by spaces.

Some BASIC keywords can be input by fewer key strokes. For example, the word "PRINT" can be input by Alt-P (hold Alt key down, type P key, then release Alt key). This is called as supershift key. All of the super-shift keys are listed below:

Alt-A	AUTO	Alt-N	NEXT
Alt-B	BSAVE	Alt-O	OPEN
Alt-C	COLOR	Alt-P	PRINT
Alt-D	DELETE	Alt-Q	(not assigned)
Alt-E	ELSE	Alt-R	RUN
Alt-F	FOR	Alt-S	SCREEN
Alt-G	GOTO	Alt-T	THEN
Alt-H	HEX$	Alt-U	USING
Alt-I	INPUT	Alt-V	VAL
Alt-J	(not assigned)	Alt-W	WIDTH
Alt-K	KEY	Alt-X	XOR
Alt-L	LOCATE	Alt-Y	(not assigned)
Alt-M	MERGE	Alt-Z	(not assigned)

4.2.2 Editing Programs

Use the LIST command to display an entire program or range of lines on the screen so that they can be edited with the full screen editor. Text can then be modified by moving the cursor to the place where the change is needed and then performing one of the following actions:

1. Typing over existing characters
2. Deleting characters to the right of the cursor
3. Deleting characters to the left of the cursor
4. Inserting characters
5. Appending characters to the end of the logical line

These actions are performed by special keys assigned to the various full screen editor functions (see the next section).

Changes to a line are recorded when a carriage return is entered while the cursor is somewhere on that line. The carriage return enters all changes for that logical line, and, up to the 255 character line limitation, no matter how many physical lines are included and no matter where the cursor is located on the line.

4.2.3 Control Characters

Table 4-1 lists the hexadecimal codes for the GW-BASIC control characters and summarizes their functions. The Control-key sequence normally assigned to each function is also listed.

Individual control functions are described following Table 4-1.

Table 4-1. GW-BASIC Control Functions.

Hex. Code	Control Key	Function	Equivalent
02	Ctrl-B	Move cursor to start of previous word	
03	Ctrl-C	Break	Ctrl-Scroll Lock
05	Ctrl-E	Truncate line (clear text to end of logical line)	
06	Ctrl-F	Move cursor to start of next word	Ctrl-→
07	Ctrl-G	Beep	
08	Ctrl-H	Backspace, deleting characters passed over	BS
09	Ctrl-I	Tab (8 spaces)	Tab
0A	Ctrl-J	Linefeed	
0B	Ctrl-K	Move cursor to home position	Home
0C	Ctrl-L	Clear window	Ctrl-Home
0D	Ctrl-M	Carriage return (enter current logical line)	RETURN
0E	Ctrl-N	Append to end of line	End
12	Ctrl-R	Toggle insert/typeover mode	Ins
1B	Ctrl-[	Ignored or start of control sequence (GW-BASIC option)	
1C	Ctrl-\	Cursor right	→
1D	Ctrl-]	Cursor left	←
1E	Ctrl-^	Cursor up	↑
1F	Ctrl-_	Cursor down (underscore)	↓

4.2.4 Logical Line Definition with INPUT

Normally, a logical line consists of all the characters on each of the physical lines that make up the logical line. During execution of an INPUT or LINE INPUT statement, however, this definition is modified slightly to allow for forms input. When either of these statements is executed, the logical line is restricted to characters actually typed or passed over by the cursor. The insert and delete modes move only characters that are within that logical line, and delete mode will decrement the size of the line.

Insert mode increments the logical line except when the characters moved will write over non-blank characters that are on the same physical line but not part of the logical line. In this case, the non-blank characters not part of the logical line are preserved and the characters at the end of the logical line are thrown out. This preserves labels that existed prior to the INPUT statement.

4.2.5 Editing Lines with Syntax Errors

When a syntax error is encountered during program execution, GW-BASIC prints the line containing the error and enters direct mode. you can correct the error, enter the change, and reexecute the program. When a line is modified, all files are closed, and all variables are lost. Thus, if the user wishes to examine the contents of variables just before the syntax error was encountered, the user should print the values before modifying the program line. Alternative ways to get to direct mode without erasing variable values or closing files are the STOP and END commands.

CHAPTER 5
WORKING WITH FILES AND DEVICES

This chapter discusses the way files and devices are used and addressed in GW-BASIC 3.1 and the way information is input and output through the system.

5.1 Default Device

When a filespec is given (in commands or statements such as FILES, OPEN, KILL), the default (current) disk drive is the one that was the default in MS-DOS before GW-BASIC was invoked.

5.2 Device-Independent Input/Output

Microsoft GW-BASIC 3.1 provides device-independent input/output that permits flexible approaches to data processing. Using device independent I/O means that the syntax for access is the same for any device.

The following statements, commands, and functions support device-independent I/O (see individual descriptions in Chapter 7):

BLOAD	LOF
BSAVE	MERGE
CHAIN	OPEN
CLOSE	POS
EOF	PRINT
GET	PRINT USING
INPUT	PUT
INPUT$	RUN
LINE INPUT	SAVE
LIST	WIDTH
LOAD	WRITE
LOC	

5.3 Filenames And Paths

GW-BASIC 3.1 uses MS-DOS's enhanced directory structure, allowing files to be accessed through their pathname.

5.3.1 Filename Specifications

File specifications follow MS-DOS naming conventions. All filespecs may begin with a device specification such as A: or B: or COM1: or LPT1:. If no device is specified, the current drive is assumed. The default extension .BAS is appended to filenames used in LOAD, SAVE, MERGE and RUN <*filename*> commands, if no period (.) appears in the filespec and if the filename is less than nine characters long.

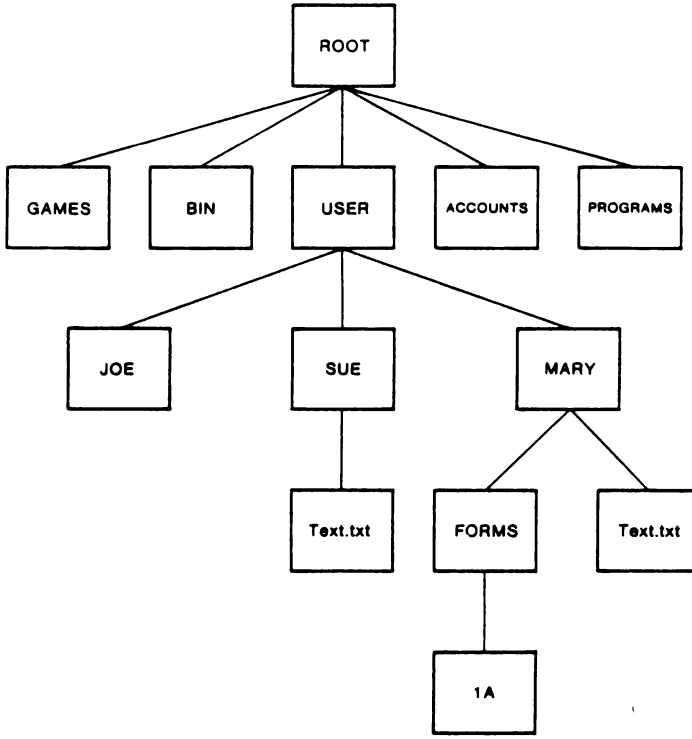
Examples:

```
RUN "NEWFILE.BAS"
RUN "A:NEWFILE.BAS"
RUN "KYBD:NEWFILE.BAS"
SAVE "NEWFILE" (file is saved with .BAS extension
                on default device)
```

5.3.2 Pathnames

A pathname is a sequence of directory names followed by a simple filename, each separated from the previous one by a backslash (\ ), and no longer than 128 characters. If a device is specified, it must be specified at the beginning of the pathname. A simple filename is a sequence of characters that can optionally be preceded by a drive designation, be devoid of backslashes, and be optionally followed by an extension.

[<*d*>:][<*directory*>]\[<*directory...*>]\[<*filename*>]



A Sample Hierarchical Directory Structure

In the structure shown above, directories are in all upper-case letters. The two entries named Text.txt, and the entry named 1A are files.

If a pathname begins with a backslash, MS-DOS searches for the file beginning at the root (or top) of the tree. Otherwise, MS-DOS begins at the user's current directory, known as the working directory, and searches downward from there.

The pathname of Sue's TEXT.TXT file is \ USER \ SUE \ TEXT.TXT.

When you are in your working directory, a filename and its corresponding pathname may be used interchangeably. Some sample names are:

\	Indicates the root directory.
\ PROGRAMS	Sample directory under the root directory containing program files.
\ USER \ MARY \ FORMS \ 1A	A typical full pathname. This one happens to be a file named 1A in the directory named FORMS belonging to a subdirectory of USER named MARY.
USER \ SUE	A relative pathname; it names the file or directory SUE in subdirectory USER of the working directory. If the working directory is the root (\), (\), it names \ USER \ SUE.
Text.txt	Name of a file or directory in the working directory.

MS-DOS provides special shorthand notations for the *working* directory and the *parent* directory (one level up) of the working directory:

> MS-DOS uses this shorthand notation to indicate the name of the working directory in all hierarchical directory listings. MS-DOS automatically creates this entry when a directory is made.

The shorthand name of the working directory's parent directory. If you type:

```
DIR..
```

then MS-DOS will list the files in the parent directory of your working directory.

If you type:

```
DIR ..\..
```

then MS-DOS will list the files in the parent's PARENT directory.

5.3.3 Working With Pathnames in BASIC

Not only can BASIC provide the ability to access files from other directories using pathname approaches, but it can also be used to create, change, and remove paths, using the BASIC commands MKDIR, CHDIR, and RMDIR.

The BASIC statement MKDIR "ACCOUNTS" would create a new directory, ACCOUNTS, in the working directory of the current drive.

The BASIC statement CHDIR "B:EXPENSES" would change the current directory on B: to EXPENSES.

The BASIC statement RMDIR "CLIENTS" would delete an existing directory, CLIENTS, as long as that directory was empty of all files with the exception of "." and "..".

For further information on handling paths in BASIC, see CHDIR, ENVIRON, ENVIRON$, MKDIR, and RMDIR Statements in Chapter 7.

5.4 Re-direction Of Standard Input And Standard Output

BASIC can be re-directed to read from standard input and write to standard output by providing the input and output filenames on the command line:

BASICA [*program name*] [<*input file*] [>*output file*]

Note that the characters "<" before the input file, and ">" before the output file are literally those characters, and not angle brackets indicating a required argument. If two greater-than characters (">>") appear before the output file name, the output is appended to that file.

Rules:

1. When re-directed, all INPUT, LINE INPUT, INPUT$, and INKEY$ statements will read from the input file.

2. If the program does not specify a file number in a PRINT statement, that output is redirected to the declared output file instead of the standard output device, the screen.

3. Error messages go to standard output.

4. File input from "KYBD:" still reads from the keyboard.

5. File output to "SCRN:" still outputs to the screen.

6. BASIC will continue to trap keys from the keyboard when the ON KEY (n) statement is used.

7. The printer echo key will not cause LPT1: echoing if Standard Output has been re-directed.

8. Typing Control-Break will cause BASIC to close any open files, issue the message "Break in line <line number>" to standard output, and exit BASIC.

9. When input is redirected, BASIC will continue to read from this source until an end-of-file character is detected. This condition may be tested with the EOF function. If the file is not terminated by a Control-Z, or a BASIC input statement tries to read past end-of-file, then any open files are closed, the message "Read past end" is written to standard output, and BASIC terminates.

Examples:

BASICA MYPROG > DATA.OUT

Data read by INPUT and LINE INPUT will continue to come from the keyboard. Data output by PRINT will go into the file DATA.OUT.

BASICA MYPROG < DATA.IN

Data read by INPUT and LINE INPUT will come from DATA.IN. Data output by PRINT will continue to go to the screen.

BASICA MYPROG < MYINPUT.DAT > MYOUTPUT.DAT

Data read by INPUT and LINE INPUT will now come from the file MYINPUT.DAT and data output by PRINT will go into MYOUTPUT.DAT.

BASICA MYPROG < \ SALES \ JOHN \ TRANS.
> > \ SALES \ SALES.DAT

Date read by INPUT and LINE INPUT will now come from the file \ SALES \ JOHN \ TRANS. Data output by PRINT will be appended to the file \ SALES \ SALES.DAT.

5.5 Handling Files

File I/O procedures for the beginning BASIC user are examined in this section. If you are new to BASIC, or if you are encountering file-related errors, read through these procedures and program examples to make sure you are using all the file statements correctly.

5.5.1 Program File Commands

The following is a review of the commands and statements used in program file manipulation. All file specifications may include the device and pathname.

SAVE <*filespec*>{[,A|P]} Writes the program that currently resides in memory to the specified file. Option A writes the program as a series of ASCII characters. With option P, BASIC will encode the file in a read-protected format.

LOAD <*filespec*>[,R] Loads the program from file into memory. The optional R runs the program immediately. LOAD always deletes the current contents of memory and closes all files before loading. If R is included, however, open data files are kept open. Thus, programs can be chained or loaded in sections and access the same data files. (LOAD <*filespec*> ,R and RUN <*filespec*> ,R are equivalent.)

RUN <*filespec*> [,R] Loads the program from file into memory and runs it. RUN deletes the current contents of memory and closes all files before loading the program. If the R option is included, however, all open data files are kept open. (RUN <*filespec*> ,R and LOAD <*filespec*> ,R are equivalent.)

MERGE <*filespec*> Loads the program from file into memory but does not delete the current contents of memory. The program line numbers in the file are merged with the line numbers

in memory. If two lines have the same number, only the line from the file program is saved. After a MERGE command is executed, the "merged" program resides in memory, and BASIC returns to command level. In order to successfully MERGE a program, the <*filespec*> must have been saved in ASCII format.

CHAIN [MERGE] <*filespec*> [,[<*line number exp*>] [,ALL] [,DELETE <*range*>]]

where <*line number expression*> is the line number in the new program at which the program is to start execution. Passes control to the named program, and passes the use of the variables and their current values to the new program. The user may choose to start the new program on a specified line, delete some lines, or transfer the values of only some of the variables.

KILL <*filespec*>

Deletes the file from the disk. <*filespec*> can be a program file or a sequential or random access data file.

NAME <*old filespec*>
AS <*new filespec*>

Changes the name of a file. NAME AS <*filespec*> can be used with program files, random access files, or sequential files. Pathnames are not permitted.

5.5.2 Protecting Program Files

If you wish to have a program saved in an encoded binary format, use the "Protect" option with the SAVE command. For example:

```
SAVE "MYPROG",P
```

A program saved this way cannot be listed or edited. You may also want to save an unprotected copy of the program for listing and editing purposes.

5.6 Data Files: Sequential And Random Access I/O

There are two types of disk data files that can be created and accessed by a BASIC program: sequential files and random access files.

5.6.1 Sequential Files

Sequential files are easier to create than random access files, but are limited in flexibility and speed when it comes to locating data. The data written to a sequential file is a series of ASCII characters stored, one item after another (sequentially), in the order sent. The data is read back sequentially, one item after another.

The following statements and functions are used with sequential data files in sequential order.

OPEN
PRINT #
PRINT #USING
WRITE #
INPUT #
INPUT$
LINE INPUT #
EOF
LOC
LOF
CLOSE

5.6.2 Creating a Sequential File

Program 1 is a short program that creates a sequential file, "DATA," from information you input at the keyboard.

```
10 OPEN "O",#1,"DATA"
20 INPUT "NAME";N$
25 IF N$ = "DONE" THEN END
30 INPUT "DEPARTMENT";DEPT$
40 INPUT "DATE HIRED";HIREDATE$
50 PRINT #1,N$;".";DEPT$;",";HIREDATE$
60 PRINT
70 GOTO 20

RUN

NAME? SAMUEL GOLDWYN
DEPARTMENT? AUDIO/VISUAL AIDS
DATE HIRED? 01/12/72

NAME? MARVIN HARRIS
DEPARTMENT? RESEARCH
DATE HIRED? 12/03/65

NAME? DEXTER HORTON
DEPARTMENT? ACCOUNTING
DATE HIRED? 04/27/81

NAME? STEVEN SISYPHUS
DEPARTMENT? MAINTENANCE
DATE HIRED? 08/16/81

NAME? etc.
```


As illustrated in Program 1, the following program steps are required to create a sequential file and access the data in it:

1. OPEN the file in "O" mode.

2. Write data to the file using the PRINT # statement. (WRITE # can be used instead.)

3. To access the data in the file, you must CLOSE the file and reopen it in "I" mode.

4. Use the INPUT # statement to read data from the sequential file into the program.

5.6.3. Reading Data From a Sequential File

Now look at Program 2. It accesses the file "DATA" that was created in Program 1 and displays the name of everyone hired in 1981.

Program 2—Accessing a Sequential File

```
10 OPEN"I",#1,"DATA"
20 INPUT#1,N$,DEPT$,HIREDATE$
30 IF RIGHT$(HIREDATE$,2)="81" THEN PRINT N$
40 GOTO 20
RUN

DEXTER HORTON
STEVEN SISYPHUS
Input past end in 20
```

Program 2 reads, sequentially, every item in the file, and prints the names of employees hired in 1981. When all the data has been read, line 20 causes an INPUT PAST END error. To avoid this error, use the WHILE...WEND control structure, which uses the EOF function to test for the end-of-file. The revised program looks like:

```
10 OPEN"I",#1,"DATA"
15 WHILE NOT EOF(1)
20    INPUT#1,N$,DEPT$,HIREDATE$
30    IF RIGHT$(HIREDATE$,2)="81" THEN PRINT N$
40 WEND
```

A program that creates a sequential file can also write formatted data to the disk with the PRINT# USING statement. For example, the statement

```
PRINT#1,USING "#####.##,";A,B,C,D
```

could be used to write numeric data to the file without explicit delimiters. The commas at the end of the format string separate the items in the disk file.

If the user wants commas to appear in the file as delimiters between variables, the WRITE statement can be used. For example, the statement

```
WRITE 1, A, B$
```

could be used to write these two variables to the file with commas delimiting them.

The LOC function, when used with a sequential file, returns the number of sectors that have been written to or read from the file since it was opened. A sector is a 128-byte block of data.

5.6.4 Adding data to a Sequential File

If you have a sequential file residing on disk and want to add more data to the end of it, you cannot simply open the file in "O" mode and start writing data. As soon as you open a sequential file in the output ("O") mode, you destroy its current contents.

Instead, use the append ("A") mode. If the file doesn't already exist, the open statement will work exactly as it would if output ("O") mode had been specified.

The following procedure can be used to add data to an existing file called "FOLKS"

Program 3—Adding Data to a Sequential File

```
110 OPEN "A",#1,"FOLKS"
120 REM ADD NEW ENTRIES TO FILE
130 INPUT "NAME";N$
140 IF N$="" THEN 210 'CARRIAGE RETURN
EXITS INPUT LOOP
150 LINE INPUT "ADDRESS?";ADDR$
160 LINE INPUT "BIRTHDAY? ";BIRTHDATE$
170 PRINT#1,N$
180 PRINT#1,ADDR$
190 PRINT#1,BIRTHDATE$
200 GOTO 120
210 CLOSE 1
```

5.6.5 Random Access Files

Creating and accessing random access files requires more program steps than creating and accessing sequential files. However, there are advantages to using random access files. One advantage is that random access files require less room on the disk, since BASIC stores them in a packed binary format. (A sequential file is stored as a series of ASCII characters.)

The biggest advantage of using random access files is that data can be accessed randomly, i.e., anywhere on the disk. However, it is not necessary to read through all the information from the beginning of the file, as with sequential files. This is possible because the information is stored and accessed in distinct units called records, each of which is numbered.

The statements and functions that are used with random access files are:

Statements and Functions

OPEN	CVD
FIELD	CVI
GET	CVS
LOC	MKS$
LOF	MKD$
LSET	MKI$
RSET	
PUT	
CLOSE	

5.6.6 Creating a Random Access File

Program 4—Create a Random File

```
10 OPEN "R", #1,"FILE",32
20 FIELD #1,20 AS N$, 4 AS A$,8 AS P$
30 INPUT "2—DIGIT CODE";CODE%
40 INPUT "NAME";PERSON$
50 INPUT "AMOUNT";AMOUNT
60 INPUT "PHONE";TELEPHONE$
65 PRINT:IF PERSON$ = "DONE" THEN END
70 LSET N$ = PERSON$
80 LSET A$ = MKS$(AMOUNT)
90 LSET P$ = TELEPHONE$
100 PUT #1,CODE%
110 GOTO 30
```

As illustrated by Program 4, the following program steps are required to create a random access file.

1. OPEN the file for random access ("R" mode). The following example specifies a record length of 32 bytes. If the record length is not specified, the default is 128 bytes unless it was set to another value with the /S: switches when invoking BASIC (See Chapter 2 for details).

   Example:

   ```
   OPEN "R", 1, "FILE",32
   ```

2. Use the FIELD statement to allocate space in the random buffer for the variables that will be written to the random access file.

   Example:

   ```
   FIELD #1,20 AS N$, 4 AS ADDR$, 8 AS P$
   ```

3. Use LSET to move the data into the random access buffer. Numeric values must be made into strings when placed in the buffer. To do this, use the "make" functions: MKI$ to make an integer value into a string, MKS$ to make a single precision value into a string, and MKD$ to make a double precision value into a string.

Example:

```
LSET N$ = X$
LSET ADDR$ = MKS$(AMT)
LSET P$ = TEL$
```

4. Write the data from the buffer to the disk using the PUT statement.

   Example:

   ```
   PUT #1,CODE%
   ```

Program 4 takes information that is input at the terminal and writes it to a random access file. Each time the PUT statement is executed, a record is written to the file. The two-digit code that is input in line 30 becomes the record number.

NOTE

Do not use a fielded string variable in an INPUT or LET statement. Doing so causes that variable to be redeclared; BASIC will no longer associate that variable with the file buffer, but with the new program variable.

5.6.7 Accessing a Random Access File

Program 5 accesses the random access file "FILE" that was created in Program 4. By entering a three-digit code at the keyboard terminal, the information associated with that code is read from the file and displayed.

Program 5—Access a Random File

```
10 OPEN "R", #1,"FILE",32
20 FIELD #1, 20 AS N$, 4 AS A$, 8 AS P$
30 INPUT "2-DIGIT CODE";CODE%
40 GET #1, CODE%
50 PRINT N$
60 PRINT USING "$$# # #.# #";CVS(A$)
70 PRINT P$:PRINT
80 GOTO 30
```

The following program steps are required to access a random access file:

1. OPEN the file in "R" mode.

   Example:

   ```
   OPEN "R", 1,"FILE",32
   ```

2. Use the FIELD statement to allocate space in the random access buffer for the variables that will be read from the file.

   Example:

   ```
   FIELD #1 20 AS N$, 4 AS A$, 8 AS P$
   ```

NOTE

In a program that performs both input and output on the same random access file, you can often use just one OPEN statement and one FIELD statement.

3. Use the GET statement to move the desired record into the random access buffer.

   Example:

   ```
   GET #1,CODE%
   ```

4. The data in the buffer can now be accessed by the program. Numeric values that were converted to strings by the MKS$, MKD$ or MKI$ statements must be converted back to numbers using the "convert" functions:CVI for integers, CVS for single precision values, and CVD for double precision values. The MKI$ and CVI processes mirror each other, the former converting a number into a format for storage in random files, the latter converting the random file storage into a format usable by the program.

   Example:

   ```
   PRINT N$
   PRINT CVS(AS)
   ```

The LOC function when used with random access files, returns the "current record number." The current record number is the last record number that was used in a GET or PUT statement. For example, the statement

```
IF LOC(1) > 50 THEN END
```

ends program execution if the current record number in file #1 is greater than 50.

5.6.8. Random File Operations

Program 6 is an inventory program that illustrates random file access.

Program 6—Inventory

```
120 OPEN"R",#1,"INVEN.DAT",39
125 FIELD#1,1 AS F$,30 AS D$,2 AS Q$,2 AS R$,4 AS
P$
130 PRINT:PRINT "FUNCTIONS:":PRINT
135 PRINT "1,INITIALIZE FILE"
140 PRINT "2,CREATE A NEW ENTRY"
150 PRINT "3,DISPLAY INVENTORY FOR ONE PART"
160 PRINT "4,ADD TO STOCK"
170 PRINT "5,SUBTRACT FROM STOCK"
180 PRINT "6,DISPLAY ALL ITEMS BELOW
REORDER LEVEL"
190 PRINT "7,END"
220 PRINT:PRINT:INPUT"FUNCTION";FUNCTION
225 IF (FUNCTION < 1) OR (FUNCTION > 7) THEN
PRINT "BAD FUNCTION NUMBER":GOTO 130
230 ON FUNCTION GOSUB 900,250,390,480,560,680,890
240 GOTO 220
250 REM **BUILD NEW ENTRY **
260 GOSUB 840
270 IF ASC (F$)< >255 THEN INPUT "OVERWRITE";
ADDR$: IF ADDR$< >"Y" THEN RETURN
280 LSET F$=CHR$(0)
290 INPUT "DESCRIPTION"; DESCRIPTION$
300 LSET D$=DESCRIPTION$
310 INPUT "QUANTITY IN STOCK";QUANTITY%
320 LSET Q$=MKI$(QUANTITY%)
330 INPUT "REORDER LEVEL";REORDER%
```

```
340 LSET R$ = MKI$(REORDER%)
350 INPUT "UNIT PRICE";PRICE
360 LSET P$ = MKS$(PRICE)
370 PUT #1,PART%
380 RETURN
390 REM ** DISPLAY ENTRY **
400 GOSUB 840
410 IF ASC(F$) = 255 THEN PRINT "NULL
ENTRY":RETURN
420 PRINT USING "PART NUMBER # # #";PART%
430 PRINT D$
440 PRINT USING "QUANTITY ON HAND
 # # # # #";CVI(Q$)
450 PRINT USING "REORDER LEVEL
 # # # # #";CVI(R$)
460 PRINT USING "UNIT PRICE $$# #.# #";CVS(P$)
470 RETURN
480 REM ADD TO STOCK
490 GOSUB 840
500 IF ASC(F$) = 255 THEN PRINT "NULL
ENTRY":RETURN
510 PRINT D$:INPUT "QUANTITY TO ADD"
;ADDITIONAL%
520 Q% = CVI(Q$) + ADDITIONAL%
530 LSET Q$ = MKI$(Q%)
540 PUT #1,PART%
550 RETURN
560 REM REMOVE FROM STOCK
570 GOSUB 840
580 IF ASC(F$) = 255 THEN PRINT "NULL
ENTRY":RETURN
590 PRINT D$
600 INPUT "QUANTITY TO SUBTRA    ";LESS%
610 Q% = CVI(Q$)
620 IF (Q%-LESS%) < 0 THEN PRINT "ONLY";Q%;"IN
STOCK":GOTO 600
630 Q% = Q%-LESS%
640 IF Q% = < CVI(R$) THEN PRINT "QUANTITY
NOW";Q%; "REORDER LEVEL";CVI(R$)
650 LSET Q$ = MKI$(Q%)
660 PUT #1,PART%
670 RETURN
680 REM DISPLAY ITEMS BELOW REORDER LEVEL
690 FOR I = 1 TO 100
```

```
710 GET #1,I
720 IF CVI(Q$)<CVI(R$) THEN PRINT D$;"QUAN-
TITY";CVI(Q$) TAB(50) "REORDER LEVEL";CVI(R$)
730 NEXT I
740 RETURN
840 INPUT "PART NUMBER";PART%
850 IF(PART% < 1)OR(PART% > 100) THEN PRINT
"BAD PART NUMBER": GOTO 840 ELSE GET #1,
PART%:RETURN
890 END
900 REM INITIALIZE FILE
910 INPUT "ARE YOU SURE";CONFIRM$:IF
CONFIRM$ < > "Y" THEN RETURN
920 LSET F$ = CHR$(255)
930 FOR I = 1 TO 100
940 PUT #1,I
950 NEXT I
960 RETURN
```

In this program, the record number is used as the part number. It is assumed the inventory will contain no more than 100 different part numbers. Lines 900-960 initialize the data file by writing CHR$(255) as the first character of each record. This is used later (line 270 and line 500) to determine whether an entry already exists for that part number.

Lines 130-220 display the various inventory functions that the program performs. When you type in the desired function number, line 230 branches to the appropriate subroutine.

5.7 BASIC And Child Processes

Through the use of the SHELL statement, GW-BASIC 2.0 is able to use one of the most powerful features of MS-DOS: the ability to create child processes. SHELL enables the user to run part of a BASIC program, temporarily exit to MS-DOS to perform a specified function, and return to the BASIC program at the statement after the SHELL statement to proceed with the rest of the program.

BASIC will produce a child program when it uses the SHELL statement. It is not possible for BASIC to totally protect itself from its children. When a SHELL statement is executed, many things may be going on. For example, files may be OPEN and devices may be in use. It is advisable for programmers to thoroughly read about the SHELL Statement, Chapter 7, before using this powerful statement.

CHAPTER 6

USING ADVANCED FEATURES

6.1 Assembly Language Subroutines

You may call assembly language subroutines from your GW-BASIC 3.1 program with the USR function or the CALL statement.

It is recommended that you use the CALL statement for interfacing 8086 machine language programs with GW-BASIC 3.1. These statements are more readable and can pass multiple arguments. In addition, the CALL statement is compatible with more languages than its alternative, the USR function.

6.1.1 Memory Allocation

Memory space must be set aside for an assembly language subroutine before it can be loaded. To do so, use the /M: switch during start-up. The /M: switch sets the highest memory location to be used by GW-BASIC 3.1.

In addition to the GW-BASIC 3.1 code area, GW-BASIC 3.1 uses up to 64K of memory beginning at its data segment (DS).

If more stack space is needed when an assembly language subroutine is called, you can save the GW-BASIC 3.1 stack and set up a new stack for use by the assembly language subroutine. The GW-BASIC 3.1 stack must be restored, however, before you return from the subroutine.

The assembly language subroutine can be loaded into memory in several ways, the most simple being to use the BLOAD command (see BLOAD Command). Also, the user could SHELL a program that exits, but stays resident, leaving the linked, relocated image in memory. As a third choice, the user could execute a program that exits but stays resident, and then run BASIC.

The following guidelines must be observed if you choose to BLOAD, or read and poke, an EXE file into memory:

1. Make sure the subroutines do not contain any long references, address offsets that exceed 64K or that take the user out of the code segment. These long references require handling by the EXE loader.

2. Skip over the first 512 bytes (the header) of the linker's output file (EXE), then read in the rest of the file.

6.1.2 Internal Representation

The following section describes the internal representation of numbers in GW-BASIC. Knowledge of these arrangements is critical for many assembly language programming routines.

Single Precision - 24 bit mantissa

```
|  0  | 1 |  2  |  3  |
|loman| S |himan| exp |
```

where loman = the low mantissa
S = the sign
himan = the high mantissa
exp = the exponent
man = himan:...:loman

- If <exp> = 0, then <number> = 0.
- If <exp> <> 0, then the mantissa is normalized and

<number> = <sgn> * .1<man> *2** (<exp>-80h)

That is, in single precision (hex notation - bytes low to high)

00000080 = .5
00008080 = -.5

Double Precision - 56 bit mantissa

```
|  0  | 1 | 2 | 3 | 4 |  | 5 |  6  |  7  |
|loman|   |   |   |   |  | S |himan| exp |
```

6.1.3 CALL Statement

The CALL statement is the recommended way of interfacing 8086 machine language subroutines with GW-BASIC 3.1. Do not use the USR function unless you are running previously written subroutines that already contain USR functions.

The syntax of the CALL statement is:

CALL <*variable name*> [(<*argument list*>)]

where <*variable name*> contains the offset into the current segment that is the starting point in memory of the subroutine being called. The current segment is either the default, or that which has been defined by a DEF SEG statement.

<*argument list*> contains the variables or constants, separated by commas, that are to be passed to the subroutine.

Invoking the CALL statement causes the following to occur:

1. For each argument in the argument list, the two-byte offset of the argument's location within the BASIC segment is pushed onto the stack.

2. Control is transferred to the subroutine with an 8086 long call to the segment address given in the last DEF SEG statement and the offset given in <*variable name*>.

Figures 6.1 and 6.2 illustrate the state of the stack at the time the CALL statement is executed, and the condition of the stack during execution of the called subroutine, respectively.

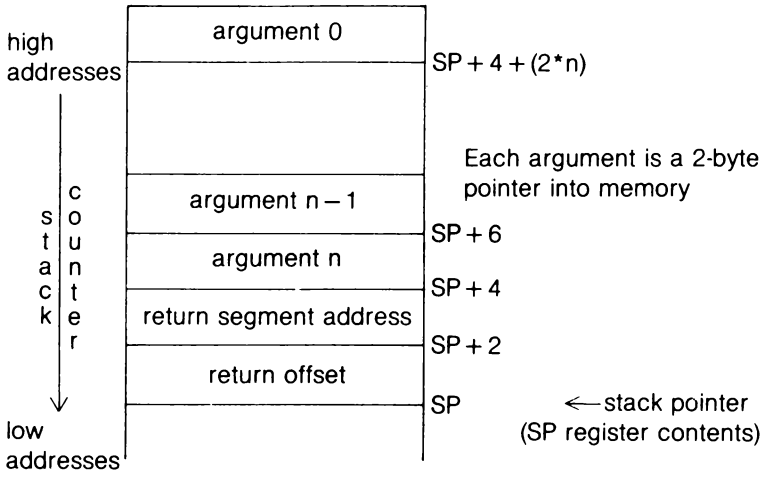


Figure 6.1. Stack layout when CALL statement is activated

After the CALL statement has been activated, the subroutine has control. Arguments may be referenced by moving the stack pointer (SP) to the base pointer (BP) and adding a positive offset to BP.

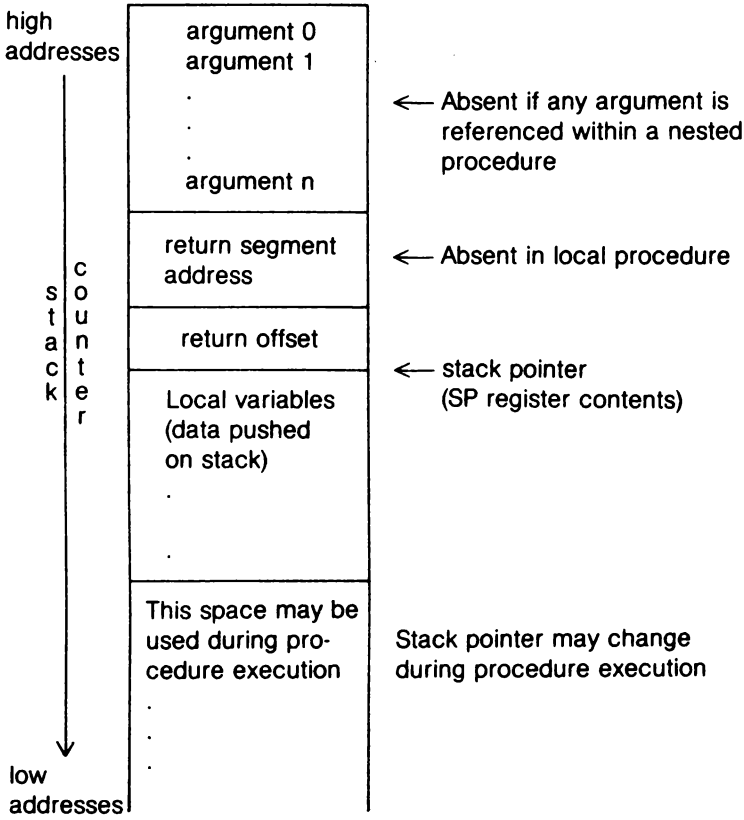

high addresses
argument 0
argument 1
argument n
← Absent if any argument is referenced within a nested procedure
return segment address
← Absent in local procedure
return offset
← stack pointer (SP register contents)
Local variables (data pushed on stack)
This space may be used during procedure execution
Stack pointer may change during procedure execution
stack counter
low addresses

Figure 6.2. Stack layout during execution of a CALL statement

Observe the following rules when coding a subroutine:

1. The called routine must preserve segment registers DS, ES, SS, and the base pointer (BP). If interrupts are disabled in the routine, they must be enabled before exiting. The stack must be cleaned up on exit.

2. The called program must know the number and length of the arguments passed. The following routine shows an easy way to reference arguments:

```
PUSH  BP
MOV   BP,SP
ADD   BP, (2*number of arguments)+4
```

   Then:

```
argument 0 is at [BP]          BP=OFFSET to argument
argument 1 is at [BP-2]        BP-2
argument n is at [BP-2*n]      BP-2*n
```

   (number of arguments = n + 1)

3. Variables may be allocated either in the code segment or on the stack. Be careful not to modify the return segment and offset stored on the stack.

4. The called subroutine must clean up the stack. A preferred way to do this is to perform a RET <n> statement (where <n> is two times the number of arguments in the argument list) to adjust the stack to the start of the calling sequence.

5. Values are returned to GW-BASIC 3.1 by including in the argument list the name of the variable that will receive the result. The internal format for numbers in GW-BASIC is discussed in "Internal Representation," Section 6.1.2.

6. If the argument is a string, the argument's offset points to 3 bytes which, as a unit, are called the "string descriptor." Byte 0 of the string descriptor contains the length of the string (0 to 255). Bytes 1 and 2, respectively, are the lower and upper 8 bits of the string starting address in string space.

Warning

If the argument is a string literal in the program, the string descriptor will point to program text. Be careful not to alter or destroy your program this way. To avoid unpredictable results, add + "" to the string literal in the program. For example, use

```
20 A$ = "BASIC" + ""
```

This will force the string literal to be copied into string space. Then the string may be modified without affecting the program.

7. The contents of a string may be altered by user routines, but the descriptor must not be changed. Do not write past the end-of-string. GW-BASIC 3.1 cannot correctly manipulate strings if their lengths are modified by external routines.

8. Data areas needed by the routine must be allocated either in the CODE segment of the user routine or on the stack. It is not possible to declare a separate data area in the user assembler routine.

Example of CALL statement:

```
100 DEF SEG = &H8000
110 FOO = &H7FA
120 CALL FOO (A,B$,C)
.
.
.
```

Line 100 sets the segment to 8000 Hex. The value of variable FOO is added into the address as the low word after the DEF SEG value is left shifted 4 bits. Here, the long call to FOO will execute the subroutine at location 8000:7FA Hex (absolute address 807FA Hex).

The following sequence in 8086 assembly language demonstrates access to the arguments passed. The returned result is stored in the variable 'C'.

```
PUSH    BP              ;Set up pointer to arguments
MOV     BP,SP
ADD     BP,(4 + 2*3)
MOV     BX,[BP-2]       ;Get address of B$ descriptor.
MOV     CL,[BX]         ;Get length of B$ in CL.
MOV     DX,1[BX]        ;Get addr of B$ text in DX.

.
MOV     SI,[BP]         ;Get address of 'A' in SI.
MOV     DI[BP-4]        ;Get pointer to 'C' in DI.
MOVS    WORD            ;Store variable 'A' in 'C'.
POP     BP              ;Restore pointer.
RET     6               ;Restore stack, return.
```

IMPORTANT

The called program must know the variable type for the numeric arguments passed. In the previous example, the instruction

```
MOVS WORD
```

will copy only two bytes. This is fine if variables A and C are integer. You would have to copy four bytes if the variables were single precision format and copy 8 bytes if they were double precision.

6.1.4 USR Function

Although using the CALL statement is the recommended way of calling assembly language subroutines, the USR function is also available for this purpose. This ensures compatibility with older programs that contain USR functions.

USR [<*digit*>] [(<*argument*>)]

where <*digit*> is from 0 to 9. <*digit*> specifies which USR routine is being called. If <*digit*> is omitted, USR0 is assumed.

<*argument*> is any numeric or string expression. Arguments are discussed in detail in the following paragraphs.

In the GW-BASIC 3.1 Interpreter, a DEF SEG statement must be executed prior to a USR function call to assure that the code segment points to the subroutine being called. The segment address given in the DEF SEG statement determines the starting segment of the subroutine.

For each USR function, a corresponding DEF USR statement must be executed to define the USR function call offset. This offset and the currently active DEF SEG address determine the starting address of the subroutine.

When the USR function call is made, register AL contains a value that specifies the type of argument that was given. The value in AL may be one of the following:

Value in AL	Type of Argument
2	Two-byte integer (two's complement)
3	String
4	Single precision floating-point number
8	Double precision floating-point number

If the argument is a number, the BX register points to the Floating-Point Accumulator (FAC) where the argument is stored.

If the argument is an integer:

FAC-2 ([DS:BX + 2]) contains the upper 8 bits of the integer.
FAC-3 ([DS:BX + 3]) contains the lower 8 bits of the integer.

For versions of GW-BASIC 3.1 that use binary floating-point:

FAC is the exponent minus 128, and the binary point is to the left of the most significant bit of the mantissa.

FAC-1 contains the highest 7 bits of mantissa with leading 1 suppressed (implied). Bit 7 is the sign of the number (0 = positive, 1 = negative).

If the argument is a single precision floating-point number:

FAC-2 contains the middle 8 bits of mantissa.
FAC-3 contains the lowest 8 bits of mantissa.

If the argument is a double precision floating-point number:

FAC-7 through FAC-4 contain four more bytes of mantissa (FAC-7 contains the lowest 8 bits).

If the argument is a string, the DX register points to 3 bytes which, as a unit, are called the "string descriptor." Byte 0 of the string descriptor contains the length of the string (0 to 255 characters). Bytes 1 and 2, respectively, are the lower and upper 8 bits of the string starting address in the GW-BASIC 3.1 data segment.

Warning

> If the argument is a string literal in the program, the string descriptor will point to program text. Be careful not to alter or destroy the program this way.

Usually, the value returned by a USR function is the same type (integer, string, single precision, or double precision) as the argument that was passed to it.

6.2 Event Trapping

Event trapping allows a program to transfer control to a specific program line when a certain event occurs. Control is transferred as if a GOSUB statement had been executed to the trap routine starting at the specified line number. The trap routine, after servicing the event, executes a RETURN statement that causes the program to resume execution at the place where it was when the event trap occurred.

The events that can be trapped are receipt of characters from a communications port (ON COM), detection of certain keystrokes (ON KEY), time passage (ON TIMER), emptying of the background music queue (ON PLAY), joystick trigger activation (ON STRIG), and lightpen activation (ON PEN).

This section gives an overview of event trapping. For more details on individual statements, see Chapter 7.

Event trapping is controlled by the following statements:

<*event specifier*> ON to turn on trapping
<*event specifier*> OFF to turn off trapping
<*event specifier*> STOP to temporarily turn off trapping

where <*event specifier*> is one of the following:

COM (*n*) where n is the number of the communications channel. The *n* in (*n*) is the same device referred to in COMn:. The COM channels are numbered 1 or 2.

Typically, the COM trap routine will read an entire message from the COM port before returning. We do not recommend using the COM trap for single character messages because at high baud rates the overhead of trapping and reading for each character may allow the interrupt buffer for COM to overflow.

KEY (*n*) where n is a trappable key number. Trappable keys are numbered 1 through 20.

Note that KEY (*n*) ON is not the same statement as KEY ON. KEY (*n*) ON sets an event trap for the specified key. KEY ON displays the values of all the function keys on the twenty-fifth line of the screen.

When the GW-BASIC Interpreter is in direct mode function keys maintain their standard meanings.

When a key is trapped, that occurrence of the key is destroyed. Therefore, you cannot subsequently use the INPUT or INKEY$ statements to find out which key caused the trap. So if you wish to assign different functions to particular keys, you must set up a different subroutine for each key, rather than assigning the various functions within a single subroutine.

PEN Since there is only one lightpen, no number is given when PEN trapping is enabled. For discussion of PEN used as a function, see Chapter 7.

TIMER ON TIMER (*n*), where (*n*) is a numeric expression representing a number of seconds since the previous midnight. The ON TIMER statement can be used to perform background tasks at defined intervals.

PLAY ON PLAY (*n*), where (*n*) is a number of notes left in the music buffer. The ON PLAY statement is used to retrieve more notes from the background music queue, to permit continuous background music during program execution.

STRIG (*n*) where *n* is the number of the joystick trigger. The range for *n* is 0 through 3.

For discussion of STRIG used as a function, see Chapter 7.

6.2.1 ON GOSUB Statement

The ON GOSUB statement sets up a line number for the specified event trap. The format is:

ON <*event specifier*> GOSUB <*line number*>

A <*line number*> of zero disables trapping for that event.

When an event is ON and if a non-zero line number has been specified in the ON GOSUB statement, every time GW-BASIC starts a new statement it will check to see if the specified event has occurred (e.g., the lightpen has been struck or a COM character has come in). When an event is OFF, no trapping takes place, and the event is not remembered even if it takes place.

When an event is stopped (<*event specifier*> STOP), no trapping takes place, but the occurrence of an event is remembered so that an immediate trap will take place when an <*event specifier*> ON statement is executed.

When a trap is made for a particular event, the trap automatically causes a STOP on that event, so recursive traps can never occur. A return from the trap routine automatically executes an ON statement unless an explicit OFF has been performed inside the trap routine.

Note that once an error trap takes place, all trapping is automatically disabled. In addition, event trapping will never occur when GW-BASIC is not executing a program.

6.2.2 RETURN Statement

When an event trap is in effect, a GOSUB statement will be executed as soon as the specified event occurs. For example, the statement

ON PEN GOSUB 1000

specifies that the program go to line 1000 as soon as the pen is used. If a simple RETURN statement is executed at the end of this subroutine, program control will return to the statement following the one where the trap occurred. When the RETURN statement is executed, its corresponding GOSUB return address is cancelled.

GW-BASIC includes the RETURN <*line number*> enhancement, which lets processing resume at a definable line. Normally, the program returns to the statement immediately following the GOSUB statement when the RETURN statement is encountered. However, RETURN <*line number*> enables the user to specify another line. If not used with care, however, this capability may cause problems. Assume, for example, that your program contains:

```
10 ON PEN GOSUB 1000
20 FOR I=1 to 10
30 PRINT I
40 NEXT I
50 REM NEXT PROGRAM LINE

200 REM PROGRAM RESUMES HERE

1000 'FIRST LINE OF SUBROUTINE
.
.
.
1050 RETURN 200
```

If the pen is activated while the FOR/NEXT loop is executing, the subroutine will be performed, but program control will return to line 200 instead of completing the FOR/NEXT loop. The original GOSUB entry will be cancelled by the RETURN statement, and any other GOSUB, WHILE, or FOR (e.g., an ON STRIG statement) that was active at the time of the trap will remain active. But the current FOR context will also remain active, and a "FOR without NEXT" error may result.

CHAPTER 7

BASIC COMMANDS, FUNCTIONS AND STATEMENTS

ABS Function

Syntax: BAS (*x*)

Purpose: To return the absolute value of the expression x.

Example: PRINT ABS (7*(−5))

will yield

35

ASC Function

Syntax: ASC (*x$*)

Purpose: To return a numerical value that is the ASCII code for the first character of the string *x$*. (See Appendix D for ASCII codes.)

Remarks: If *x$* is null, an "Illegal function call" error is returned.

Example:

```
10 X$ = "TEST"
20 PRINT ASC(X$)
```

will yield

```
 84
```

See the CHR$ function, for details on ASCII-to-string conversion.

ATN Function

Syntax: ATN (*x*)

Purpose: To return the arctangent of *x*, where *x* is in radians. Result is in the range −pi/2 to pi/2 radians. (where pi = 3.14159)

Remarks: The expression *x* may be any numeric type, but the default evaluation of ATN is performed in single precision. This may be overridden if the /D switch is used when invoking GW-BASIC 2.0.

Example:

```
10 LET X = 3
20 PRINT ATN(X)
```

will yield

```
 1.249046
```

AUTO Command

Syntax: AUTO [<*line number*>[,<*increment*>]]

Purpose: To automatically generate line numbers during program entry.

Remarks: AUTO begins numbering at <*line number*> and increments each subsequent line number by <*increment*>. The default for both values is 10. If <*line number*> is followed by a comma but <*increment*> is not specified, the last increment specified in an AUTO command is assumed.

If AUTO generates a line number that is already being used, an asterisk (*) is printed after the number to warn the user that any input will replace the existing line. However, typing a carriage return immediately after the asterisk will save the existing line and generate the next line number.

If the cursor is moved to another line on the screen, numbering will resume there.

AUTO is terminated by typing CTRL-C or BREAK (CTRL-Scroll Lock) keys. The line in which the termination is done will not be saved. After the termination key is typed, Microsoft GW-BASIC returns to command level.

Example:

AUTO 100,50	Generates line numbers 100, 150, 200....
AUTO	Generates line numbers 10, 20, 30, 40....

BEEP Statement

Syntax: BEEP

Purpose: To sound the speaker.

Remarks: The BEEP statement sounds the ASCII bell character. This statement has the same effect as PRINT CHR$(7).

Example:

```
20 IF X<20 THEN BEEP
```

This example executes a beep when X is less than 20.

BLOAD Command

Syntax: BLOAD <*filespec*> [,<*offset*>]

The device designation portion of the filespec is optional. The filename, not including the device designation, may be 1 to 8 characters long.

<*offset*> is a numeric expression returning an unsigned integer in the range 0 to 65535. This is the offset address at which loading is to start in the segment declared by the last DEF SEG statement.

Purpose: To load a specified memory image file into memory from any input device.

Remarks: The BLOAD statement allows a program or data that has been saved as a memory image file to be loaded anywhere in memory. A memory image file is a byte-for-byte copy of what was originally in memory. See BSAVE Command, for information about saving memory image files.

If the offset is omitted, the segment address and offset contained in the file (i.e., the address specified by the BSAVE statement when the file was created) are used. Therefore, the file is loaded into the same location from which it was saved.

If offset is specified, the segment address used is the one given in the most recently executed DEF SEG statement. If no DEF SEG statement has been given, the GW-BASIC data segment will be used as the default (because it is the default for DEF SEG).

CAUTION

BLOAD does not perform an address range check. It is therefore possible to load a file anywhere in memory. The user must be careful not to load over GW-BASIC or the operating system.

Example 1:

```
10 'Load subroutine at 6000:F000
20 DEF SEG = &H6000 'Set segment to 6000 Hex
30 BLOAD "PROG1",&HF000 'Load PROG1
```

This example sets the segment address at 6000 Hex and loads PROG1 at F000

Example 2:

```
10 'Save screen buffer
20 DEF SEG = &HB800 'Set segment to B800 Hex
30 BSAVE "A:SCREEN" ,0, &H4000
.
.
.
110 'Load picture
120 DEF SEG = &HB800
130 BLOAD "A:SCREEN" ,0
```

This example saves information currently stored into the video-RAM on a color display board into disk (refer to BSAVE command on next page), and then re-loads it into video-RAM.
The hexadecimal number &HB800 shows the entry address in the video-RAM. The BSAVE and BLOAD commands are useful when storing data into files or loading it from files.

BSAVE Command

Syntax: BSAVE <*filespec*>,<*offset*>,<*length*>

The device designation portion of the filespec is optional. The filename, not including the device specification, must be 1 to 8 characters long.

<*offset*> is a numeric expression returning an unsigned integer in the range 0 to 65535. This is the offset address to start saving from in the segment declared by the last DEF SEG statement.

<*length*> is a numeric expression returning an unsigned integer in the range 1 to 65535. This is the length in bytes of the memory image file to be saved.

Purpose: To transfer the contents of the specified area of memory to any output device.

Remarks: The <*filespec*>, <*offset*>, and <*length*> are required in the syntax.

The BSAVE command allows data or programs to be saved as memory image files on disk. A memory image file is a byte-for-byte copy of what is in memory.

If the offset is omitted, a "Syntax error" error message is issued and the save is terminated. A DEF SEG statement must be executed before the BSAVE. The last known DEF SEG address will be used for the save.

If length is omitted, a "Syntax error" error message is issued and the save is terminated.

Example:

```
10 'Save PROG1
20 DEF SEG = &H6000
30 BSAVE"PROG1",&HF000,256
```

This example saves 256 bytes starting at 6000:F000 in the file PROG1.

For another example, see the BLOAD command in the previous page.

CALL and CALLS Statements

Syntax: CALL <*variable name*>[(<*argument list*>)]
CALLS <*variable name*>[(<*argument list*>)]

where <*variable name*> contains an address that is the starting point in memory of the subroutine. <*variable name*> may not be an array variable name.

<*argument list*> contains the arguments that are passed to the external subroutine. <*argument list*> may contain only variables.

Purpose: To call an assembly language subroutine or a compiled routine written in another high level language.

Remarks: The CALL statement is one way to transfer program flow to an external subroutine. (See also the USR function.)

The CALLS statement is the same as CALL except that the segmented addresses of all arguments are ignored (CALL ignores unsegmented addresses). The CALLS statement is particularly useful when accessing routines written in the FORTRAN calling convention. All FORTRAN parameters are call-by-reference segmented addresses.

CALLS uses the segment address specified in the last executed DEF SEG statement to locate the routine being called.

See Section 6.1.3., CALL Statement, for a detailed discussion of calling sequences.

Example:

```
110 MYROUT = &HD000
120 CALL MYROUT(I,J,K)
.
.
.
```

CDBL Function

Syntax: CDBL (*x*)

Purpose: To convert *x* to a double precision number.

Example:

```
10 LET PI = 22/7
20 PRINT PI,CDBL(PI)
```

will yield

```
 3.142857    3.142857074737549
```

CHAIN Statement

Syntax: CHAIN [MERGE]<*filespec*>[,[<*line number exp*>] [,ALL] [,DELETE <*range*>]]

See the examples below for illustration of the syntax options.

Purpose: To call a program and pass variables to it from the current program.

Remarks: <*filespec*> is a string expression containing a name that conforms to MS-DOS rules for disk filenames or GW-BASIC rules for device specifications.

<*line number exp*> is a line number or an expression that evaluates to a line number in the called program. It is the starting point for execution of the called program. If it is omitted, execution begins at the first line. <*line number exp*> is not affected by a RENUM command.

With the ALL option, every variable in the current program is passed to the called program. If the ALL option is omitted, the current program must contain a COMMON statement to list the variables that are passed. See COMMON command section.

If the ALL option is used and <*line number exp*> is not, a comma must hold the place of <*line number exp*>. For example, CHAIN "NEXTPROG",,ALL is correct; CHAIN "NEXTPROG",ALL is incorrect. In the latter case, GW-BASIC assumes that ALL is a variable name and evaluates it as a line number expression.

The MERGE option allows a subroutine to be brought into the GW-BASIC program as an overlay. That is, the current program and the called program are merged (see MERGE Command). The called program must be an ASCII file if it is to be merged.

After an overlay is used, it is usually desirable to delete it so that a new overlay may be brought in. To do this, use the DELETE option.

The line numbers in *<range>* are affected by the RENUM command.

Examples: CHAIN is used in different ways in the two examples below. In the first, the two string arrays are dimensioned, and declared as common variables. When the program gets to line 90, it chains to the other program, which loads the B$s. At line 90 of PROG2, control chains back to the first program, but line 100 is delineated, and so the first program executes from that line. This process can be observed through the descriptive text that prints as the programs execute.

Example 1:

```
10 REM THIS PROGRAM DEMONSTRATES
CHAINING USING COMMON TO PASS
VARIABLES.
20 REM SAVE THIS MODULE ON DISK AS
"PROG1" USING THE A OPTION.
30 DIM A$(2),B$(2)
40 COMMON A$(),B$()
50 A$(1) = "VARIABLES IN COMMON MUST
BE ASSIGNED"
60 A$(2) = "VALUES BEFORE CHAINING."
70 B$(1) = ""
80 B$(2) = ""
90 CHAIN "PROG2"
100 PRINT
110 PRINT B$(1)
120 PRINT
130 PRINT B$(2)
140 PRINT
150 END
```

```
10 REM THE STATEMENT "DIM
A$(2),B$(2)" MAY ONLY BE EXECUTED
ONCE.
20 REM HENCE, IT DOES NOT APPEAR IN
THIS MODULE.
30 REM SAVE THIS MODULE ON THE DISK
AS "PROG2" USING THE A OPTION.
40 COMMON A$(),B$()
50 PRINT
60 PRINT A$(1);A$(2)
70 B$(1) = "NOTE HOW THE OPTION OF
SPECIFYING A STARTING LINE NUMBER"
80 B$(2) = "WHEN CHAINING AVOIDS THE
DIMENSION STATEMENT IN 'PROG1'."
90 CHAIN "PROG1",100
100 END
```

In the second example, the MERGE, ALL, and DELETE options are illustrated. After A$ is loaded in the first program, control chains to line 1010 of the second. At the second program's line 1040, it chains to line 1010 of the third program, keeping all variables and deleting all the second program's lines.

Control passes to the third program. This process can be observed through the descriptive text that prints as the programs execute.

Example 2:

```
10 REM THIS PROGRAM DEMONSTRATES
CHAINING USING THE MERGE, ALL,
AND DELETE OPTIONS.
20 REM SAVE THIS MODULE ON THE DISK
AS "MAINPRG".
30 A$ = "MAINPRG"
40 CHAIN MERGE "OVRLAY1",1010,ALL
50 END
```

```
1000 REM SAVE THIS MODULE ON THE
DISK AS "OVRLAY1" USING THE A OPTION.
1010 PRINT A$;"HAS CHAINED TO
OVRLAY1."
1020 A$ = "OVRLAY1"
1030 B$ = "OVRLAY2"
1040 CHAIN MERGE "OVRLAY2", 1010, ALL,
DELETE 1000-1050
1050 END
```

```
1000 REM SAVE THIS MODULE ON THE
DISK AS "OVRLAY2" USING THE A OPTION.
1010 PRINT A$;" HAS CHAINED TO ";B$;"."
1020 END
```

Note: The CHAIN statement with MERGE option leaves the files open and preserves the current OPTION BASE setting.

If the MERGE option is omitted, CHAIN does not preserve variable types or user-defined functions for use by the chained program. That is, any DEFINT, DEFSNG, DEFDBL, DEFSTR, or DEFFN statements containing shared variables must be restated in the chained program.

When using the MERGE option, user-defined functions should be placed before any CHAIN MERGE statements in the program. Otherwise, the user-defined functions will be undefined after the merge is complete.

CHDIR Statement

Syntax: CHDIR *<pathname>*

Purpose: To change the current operating directory.

Remarks: *<pathname>* is a string specifying the name of the directly which is to be the current directory. CHDIR works exactly like the MS-DOS command CHDIR. The *<pathname>* must be a string of less than 64 characters.

Example 1:

```
CHDIR "SALES"
```

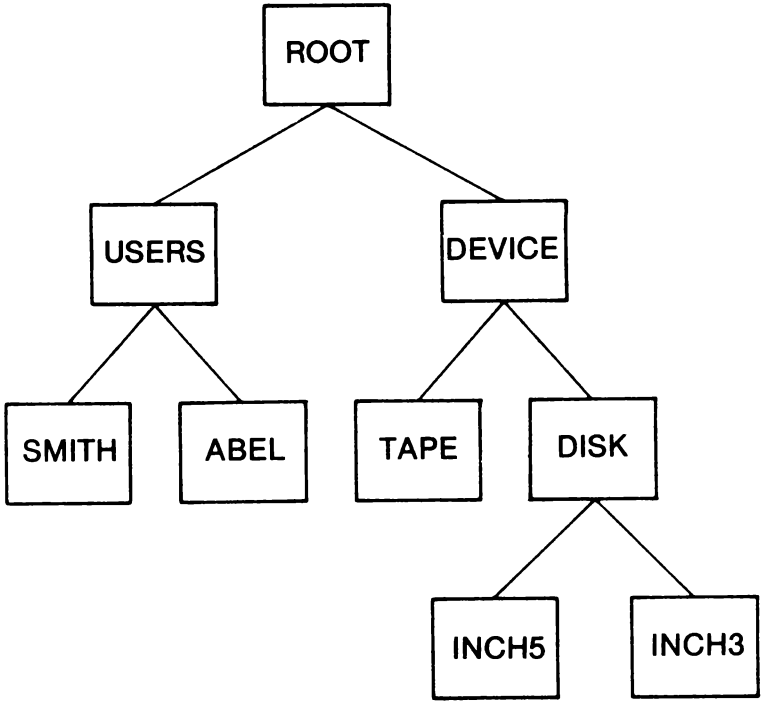
This makes SALES the current directory.

```
CHDIR "B:USERS"
```

This changes the current directory to USERS on drive B. It does NOT, however, change the default drive to B:.

Also see the MKDIR and RMDIR statements.

Example 2:



Suppose there are directories which have the above structure. To change the operating directory see the following chart.

from	to	examples on the screen
any	ROOT	CHDIR " \ "
ROOT	DEVICE	CHDIR "DEVICE" or CHDIR " \ DEVICE"
ROOT	INCH3	CHDIR " \ DEVICE \ DISK \ INCH3"
DISK	DEVICE	CHDIR ".."
INCH3	DISK	CHDIR ".. \ .."

CHR$ Function

Syntax: CHR$ (*n*)

Purpose: To return a string whose one character is ASCII character *n*. (ASCII codes are listed in Appendix D.)

Remarks: CHR$ is commonly used to send a special character to the screen or printer. For instance, the BELL character (CHR$(7)) could be sent as a preface to an error message, or a form feed (CHR$(12)) could be sent to clear a terminal screen and return the cursor to the home position.

Example 1:

```
PRINT CHR$(66)
```

will yield

```
B
```

See the ASC function, for details on ASCII-to-numeric conversion.

Example 2:

```
PRINT CHR$(34) + "A" + CHR$(34)
```

will yield

```
"A"
```

This example is useful to output a character with double quotation marks.

Example 3:

```
KEY 3, "RUN" + CHR$(13)
```

enables you to execute a BASIC program by simply pressing the F3 key without pressing the <ENTER> key since this action is already defined into that key.

CINT Function

Syntax: CINT (*x*)

Purpose: To convert *x* to an integer by rounding the fractional portion.

Remarks: If *x* is not in the range −32768 to 32767, an "Overflow" error occurs.

Example:

```
PRINT CINT(45.67)
```

will yield

```
 46
```

See the CDBL and CSNG functions for details on converting numbers to the double precision and single precision data type, respectively. See also the FIX and INT functions, both of which return integers.

CIRCLE Statement

Syntax: CIRCLE [STEP] (<*x-center*>, <*y-center*>), <*radius*> [,<*color*>[,<*start*>,<*end*> [,<*aspect*>]]]

Purpose: To draw an ellipse or circle with the specified center and radius.

The [STEP] option makes the specified center and ycenter coordinates relative to the "most recent point", instead of absolute, mapped coordinates. <*x-center*> is the x coordinate for the center of the circle.

<*y-center*> is the y coordinate for the center of the circle.

<*radius*> is the radius of the circle in the current logical coordinate system.

<*color*> is the numeric symbol for the color desired (see COLOR Statement). The default color is the foreground color.

<*start*> and <*end*> are the start and end angles in radians. The range is −2 * pi (=3.141593) through 2 * pi. These angles allow the user to specify where an ellipse will begin and end. If the start or end angle is negative, the ellipse will be connected to the center point with a line, and the angles will be treated as if they were positive. Note that this is different from adding 2 * pi.

<*aspect*> is the aspect ratio, i.e., the ratio of the x radius to the y radius. Default ratios is 5/6 for low resolution (320×200) mode, and 5/12 for high resolution (640×200) mode. When default ratios are specified for the corresponding screen mode, a round circle is drawn.

If the aspect ratio is less than one, the radius given is the x radius. If it is greater than one, the y radius is given.

Remarks: The last point referenced after a circle is drawn is the center of the circle.

It is not an error to supply coordinates that are outside the screen or viewport.

Coordinates can be shown as absolutes, as in the syntax shown above, or the STEP option can be used to reference a point relative to the most recent point used. The syntax of the STEP option is:

STEP (<*x-offset*>, <*y-offset*>)

For example, if the most recent point referenced were (10,10), STEP (10,5) would reference a point offset 10 from the current x coordinate and offset 5 from the current y coordinate, that is, the point (20,15).

Example: Assume that the last point plotted was 100,50. Then,

```
CIRCLE (200,200),50
```

and

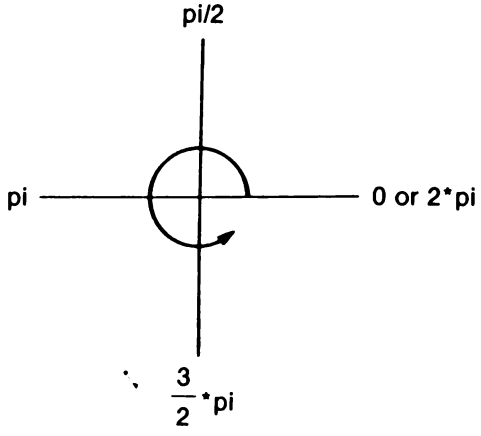
```
CIRCLE STEP (100,150),50
```

will both draw a circle at 200,200 with radius 50. The first example uses absolute notation; the second uses relative notation.

```
CIRCLE (100,100),50,,3.14, 1.57
CIRCLE (100,100),50,, -3/14, -1.57
```

```
CIRCLE (100,100),50,,,, 2.0
CIRCLE (100,100),50,,,, 0.5
```

Note: Start or end angle.



CLEAR Statement

Syntax: CLEAR [,[<*expression1*>] [,<*expression2*>]]

Purpose: To set all numeric variables to zero, all string variables to null, and to close all open files; and, optionally, to set the end of memory and the amount of stack space.

Remarks: <*expression1*> is a memory location that, if specified, sets the highest location available for use by Microsoft GW-BASIC.

<*expression2*> sets aside stack space for Microsoft GW-BASIC. The default is 768 bytes or one-eighth of the available memory, whichever is smaller.

Note: The CLEAR statement performs the following actions:

Closes all files.
Clears all COMMON variables.
Resets numeric variables and arrays to zero.
Resets the stack and string space.
Resets all string variables and arrays to null.
Releases all disk buffers.
Resets all DEF FN and DEF SNG/DBL/STR statements.

Examples:

CLEAR	clears all variables
CLEAR ,32768	clears all variables and sets the highest memory location for BASIC to 32768 bytes
CLEAR ,,2000	clears all variables and sets the stack space to 2000 bytes
CLEAR ,32768,2000	enables all above limitations.

CLOSE Statement

Syntax: CLOSE [[#]<*file number*>[,[#]<*file number...*>]]

Purpose: To conclude I/O to a file. The CLOSE statement is complementary to the OPEN statement.

Remarks: <*file number*> is the number under which the file was opened. A CLOSE with no arguments closes all open files.

The association of a particular file and a filenumber terminates upon execution of a CLOSE statement. The file may then be reopened using the same or a different file number. Once a file is closed, that file's number may be used for any unopened file.

A CLOSE for a sequential output file writes the final buffer of output.

The SYSTEM, CLEAR, and END statements and the NEW and RESET commands always close all files automatically.

Example:

```
CLOSE #1,#2
```

CLS Statement

Syntax: CLS

Purpose: Erases contents of entire current screen.

Remarks: The screen may also be cleared with the Clear Window key (see discussion of CLEAR WINDOW in Section 4.2, "Full Screen Editor".)

Example:

```
10 CLS 'Clears the screen
```

COLOR Statement (Text mode)

Syntax: COLOR [<*foreground*>] [,[<*background*>] [,<*border*>]]

Purpose: To select foreground, background and border colors.

Remarks: <*foreground*>: Foreground (for character) color. An unsigned integer in the range 0 to 31.

<*background*>: Background color. An unsigned integer in the range 0 to 7.

<*border*>: Color for the border screen. An unsigned integer in the range 0 to 15.

If your computer has the color display board, <*foreground*> can be chosen from the following range 0 to 15 and <*background*> can be chosen 0 through 7.

0 Black	8 gray
1 blue	9 light blue
2 green	10 light green
3 cyan	11 light cyan
4 red	12 light red
5 magenta	13 light magenta
6 brown	14 yellow
7 white	15 high-intensity white

A value of 16 through 31 is specified as <*foreground*>, you can make the character blink. Colors are equal to 16 plus the number in the above table.

If your computer has the monochrome display board, the following values can be selected as <*foreground*>.

0	black
1	character with underline in white foreground
2 to 7	white
9	high-intensity white with underline
10 to 15	high-intensity white

A value of 16 through 31 can also be specified to give the blinking characters on the screen. For example, the value 31 means high-intensity white blinking character.

With the monochrome display board, <*background*> can be chosen a value from 0 to 7.

0 to 6	black
7	white

To create reverse image characters on the screen (black characters with white background) specify 0, 8, 16 or 24 as <*foreground*> and 7 as <*background*>.

Notes:

These notes are applicable to both color and monochrome display boards.

If <*foreground*> and <*background*> are the same value, this makes any character displayed invisible.

If any parameter option is omitted, old parameters are assumed.

Examples: 10 COLOR 1,2,3

This sets blue foreground, green background, and cyan border screen.

```
10 'Color change in text mode
20 SCREEN 0,0 : WIDTH 40 : CLS : LOCATE
1,1
30 FOR I=0 to 15
40 COLOR I,0,0 'change color
50 FOR J=1 TO 40
60 PRINT CHR$ (219);
70 NEXT J
80 NEXT I
90 COLOR 7,0,0
```

COLOR Statement (Graphic mode)

Syntax: COLOR [<*background*>] [, <*palette*>]]

Purpose: To select the background and palette colors.

Remarks: <*background*>: Background color. An unsigned integer in the range 0 to 255, however, 0 to 15 is applicable. For detailed explanation about colors, refer to the previous COLOR Statement in text mode.

<*palette*>: Palette of colors. An unsigned integer in the range 0 to 255. Odd numbers are assumed as palette 1 and even numbered as palette 0.

Relations between colors and palettes are as follows:

Color	Palette 0	Palette 1
1	green	cyan
2	red	magenta
3	brown	white

WARNING

This type of statement is applicable only for the computer which has a color display board and in the medium resolution mode.

Notes: Optional parameters can be omitted. If omitted, parameters assume the previous value.

COLOR statement is used to specify colors to PSET, PRESET, LINE, CIRCLE, PAINT and DRAM commands.

Examples:

```
5 SCREEN 1,0
10 COLOR 1,1
```

Specifies the background color to blue and palette 1.

```
20 COLOR ,0
```

Background remains blue and palette 0 is assigned.

COM Statement

Syntax: COM (*n*) ON
COM (*n*) OFF
COM (*n*) STOP

where (*n*) is the number of the communications port. Specify 1 or 2.

Purpose: To enable or disable event trapping of communications activity on the specified port.

Remarks: The COM (*n*) ON statement enables communications event trapping by an ON COM statement (see ON COM Statement). While trapping is enabled, and if a non-zero line number is specified in the ON COM statement, GW-BASIC checks between every statement to see if activity has occurred on the communications channel. If it has, the ON COM statement is executed.

COM (*n*) OFF disables communications event trapping. If an event takes place, it is not remembered.

COM (*n*) STOP disables communications event trapping, but if an event occurs, it is remembered. If there is a subsequent COM (*n*) ON statement, the remembered event will be successfully trapped.

Note: For additional information on communications event trapping, see "Event Trapping," Section 6.2, and ON COM Statement.

Example:

```
10 COM(1)ON
```

Enables error trapping of communications activity on channel 1.

COMMON Statement

Syntax: COMMON *<list of variables>*

Purpose: To pass variables to a chained program.

Remarks: The COMMON statement is used in conjunction with the CHAIN statement. COMMON statements may appear anywhere in a program, though it is recommended that they appear at the beginning. The same variable cannot appear in more than one COMMON statement. Array variables are specified by appending "()" to the variable name. If all variables are to be passed, use CHAIN with the ALL option and omit the COMMON statement.

Some Microsoft products allow the number of dimensions in the array to be included in the COMMON statement. GW-BASIC will accept that syntax, but will ignore the numeric expression itself. For example, the following statements are both valid and are considered equivalent:

```
COMMON A()
COMMON A(3)
```

The number in parentheses is the number of dimensions, not the dimensions themselves. For example, the variable A(3) in this example might correspond to a DIM statement of DIM A(5,8,4).

Example:

```
100 COMMON A,B,C,D(),G$
110 CHAIN "PROG3",10
.
.
.
```

CONT Command

Syntax: CONT

Purpose: To continue program execution after a Break has been typed or a STOP statement has been executed.

Remarks: Execution resumes at the point where the break occurred. If the break occurred after a prompt from an INPUT statement, execution continues with the reprinting of the prompt ("?" or prompt string).

CONT is usually used in conjunction with STOP for debugging. When execution is stopped, intermediate values may be examined and changed using direct mode statements. Execution may be resumed with CONT or a direct mode GOTO, which resumes execution at a specified line number. CONT may be used to continue execution after an error has occurred.

CONT is invalid if the program has been edited during the break.

Example: See STOP Statement.

COS Function

Syntax: COS (*x*)

Purpose: To return the cosine of *x*, where *x* is in radians.

Remarks: The calculation of COS (*x*) is performed in single precision, unless the /D switch is specified when BASIC is invoked and either the argument that receives the value of the cosine is a double precision variable or (*x*) is specified a double precision number with the # sign.

Example:

```
10 X = 2*COS(.4)
20 PRINT X
```

will yield

```
 1.842122
```

CSNG Function

Syntax: CSNG (*x*)

Purpose: To convert *x* to a single precision number.

Example:

```
10 A# = 975.3421115#
20 PRINT A#, CSNG(A#)
```

will yield

```
 975.3421115    975.3421
```

See the CINT and CDBL functions for converting numbers to the integer and double precision data types, respectively.

CSRLIN Function

Syntax: CSRLIN

CSRLIN returns the current line position.

Purpose: To obtain the current line position of the cursor in a numeric variable.

Remarks: To return the current column position, use the POS function.

Example:

```
10 y = CSRLIN 'Record current line.
20 x = POS(0) 'Record current column.
30 LOCATE 24,1
40 PRINT "HELLO"
50 LOCATE y,x 'Restore position to old
line and column
```

CVI, CVS, CVD Functions

Syntax: CVI (<*2-byte string*>)
CVS (<*4-byte string*>)
CVD (<*8-byte string*>)

Purpose: To convert string values to numeric values.

Remarks: Numeric values that are read in from a random disk file must be converted from strings back into numbers. CVI converts a 2-byte string to an integer. CVS converts a 4-byte string to a single precision number. CVD converts an 8-byte string to a double precision number.

Example:

```
.
.
.
70 FIELD #1,4 AS N$, 12 AS B$, ...
80 GET #1
90 Y = CVS(N$)
.
.
.
```

See also MKI$, MKS$, MKD$ Functions.

DATA Statement

Syntax: DATA *<list of constants>*

Purpose: To store the numeric and string constants that are accessed by the program's READ statement(s). (See READ Statement.)

Remarks: DATA statements are nonexecutable and may be placed anywhere in the program. A DATA statement may contain as many constants as will fit on a line (separated by commas). Any number of DATA statements may be used in a program. READ statements access DATA statements in order (by line number). The data contained therein may be thought of as one continuous list of items, regardless of how many items are on a line or where the lines are placed in the program.

<list of constants> may contain numeric constants in any format; i.e., fixed-point, floating-point, or integer. (No numeric expressions are allowed in the list.) String constants in DATA statements must be surrounded by double quotation marks only if they contain commas, colons, or significant leading or trailing spaces. Otherwise, quotation marks are not needed.

The variable type (numeric or string) given in the READ statement must agree with the corresponding constant in the DATA statement.

DATA statements may be reread from the beginning by use of the RESTORE statement.

Example: See READ Statement.

DATE$ Statement

Syntax: DATE$ = <*string expression*>

<*string expression*> must be a string in one of the following forms:

mm-dd-yy
mm-dd-yyyy
mm/dd/yy
mm/dd/yyyy

Purpose: To set the current date. This statement complements the DATE$ function, which retrieves the current date.

Example:

```
10 DATE$ = "10-01--1985"
```

The current date is set at October 1, 1985.

DATE$ Function

Syntax: DATE$

Purpose: To retrieve the current date. (To set the date, use the DATE$ statement.)

Remarks: The DATE$ function returns a ten-character string in the form mm-dd-yyyy, where mm is the month (01 through 12), dd is the day (01 through 31), and yyyy is the year (1980 through 2099).

Example:

```
10 PRINT DATE$
```

The DATE$ function prints the date, calculated from the date set with the DATE$ statement.

DEF FN Statement

Syntax: DEF FN <*name*>[(<*parameter list*>)] = <*function definition*>

Purpose: To define and name a function that is written by the user.

Remarks: <*name*> must be a legal variable name. This name, preceded by FN, becomes the name of the function.

<*parameter list*> consists of those variable names in the function definition that are to be replaced when the function is called. The items in the list are separated by commas.

<*function definition*> is an expression that performs the operation of the function. It is limited to one logical line. Variable names that appear in this expression serve only to define the function; they do not affect program variables that have the same name. A variable name used in a function definition may or may not appear in the parameter list. If it does, the value of the parameter is supplied when the function is called. Otherwise, the current value of the variable is used.

The variables in the parameter list represent, on a one-to-one basis, the argument variables or values that will be given in the function call.

This statement may define either numeric or string functions. If a type is specified in the function name, the value of the expression is forced to that type before it is returned to the calling statement. If a type is specified in the function name and the argument type does not match, a "Type mismatch" error occurs.

A DEF FN statement must be encountered before the function it defines may be called. If a function is called before it has been defined, an "Undefined user function" error occurs. DEF FN is illegal in the direct mode.

Example:

```
.
400 I=5:J=2
410 DEF FNAB(X,Y)=X^3/Y^2
420 T=FNAB(I,J)
.
.
.
```

will yield

```
 31.25
```

Line 410 defines the function FNAB. The function is called in line 420.

DEFINT/SNG/DBL/STR Statements

Syntax: DEF <*type*> <*range(s) of letters*>

where <*type*> is INT, SNG, DBL, or STR

Purpose: To declare variable types as integer, single precision, double precision, or string.

Remarks: Any variable names beginning with the letter(s) specified in <*range of letters*> will be considered the type of variable specified in the <*type*> portion of the statement. However, a type declaration character always takes precedence over a DEF<*type*> statement. (See "Variable Names and Declaration Characters," Section 3.3.1.)

If no type declaration statements are encountered, GW-BASIC assumes that all variables without declaration characters are single precision variables.

Examples 1:

```
10 DEFDBL L-P
```

All variables beginning with the letters L, M, N, O, and P will be double precision variables.

```
10 DEFSTR A
```

All variables beginning with the letter A will be string variables.

```
10 DEFINT I-N, W-Z
```

All variables beginning with the letters I, J, K, L, M, N, W, X, Y, Z will be integer variables.

Example 2:

```
10 DEFINT I-N
20 DEFSNG O-R
30 DEFDBL A-D
40 DEFSTR S-Z
50 INTEGER=2/3
60 REAL=2/3
70 DOUBLE=2#/3#
80 STRING="DECLEAR ATTRIBUTE"
90 PRINT STRING
100 PRINT INTEGER;REAL;DOUBLE
```

will yield

```
DECLEAR ATTRIBUTE
 1    .6666667    .6666666666666667
```

DEF SEG Statement

Syntax: DEF SEG [= <*address*>]

where <*address*> is a numeric expression returning an unsigned integer in the range 0 to 65535.

Purpose: To assign the current segment address to be referenced by a subsequent BLOAD, BSAVE, CALL, CALLS, or POKE statement or by a USR or PEEK function.

Remarks: The address specified is saved for use as the segment required by BLOAD, BSAVE, CALL, POKE, USR, and PEEK.

Entry of any value outside the <*address*> range 0 through 65535 will result in an "Illegal function call" error, and the previous value will be retained.

If the <*address*> option is omitted, the segment to be used is set to the GW-BASIC data segment. This is the initial default value.

Note: DEF and SEG must be separated by a space. Otherwise, GW-BASIC will interpret the statement DEFSEG = 100 to mean "assign the value 100 to the variable DEFSEG."

Example:

```
10 DEF SEG = &HB800 'Seg segment at B800 Hex
20 DEF SEG 'Restore segment to GW-BASIC data segment
```

DEF USR Statement

Syntax: DEF USR [<*digit*>]= <*integer expression*>

Purpose: To specify the starting address of an assembly language subroutine.

Remarks: <*digit*> may be any digit from 0 to 9. The digit corresponds to the number of the USR routine whose address is being specified. if <*digit*> is omitted, DEF USR0 is assumed. The value of <*integer expression*> is the starting address of the USR routine.

Any number of DEF USR statements may appear in a program to redefine subroutine starting addresses, thus allowing access to as many subroutines as necessary.

Example:

```
.
.
.
200 DEF USR0=24000
210 X=USR0(Y^2/2.89)
.
.
.
```

DELETE Command

Syntax: DELETE {[<*line number*>][–<*line number*>]|[<*line number*>–]}

Purpose: To delete program lines.

Remarks: Microsoft GW-BASIC always returns to command level after a DELETE is executed. If <*line number*> does not exist, an "Illegal function call" error occurs.

Examples:

DELETE 40	Deletes line 40.
DELETE 40–100	Deletes line 40 though 100, inclusive.
DELETE –40	Deletes all lines up to and including line 40.
DELETE 40–	Deletes lines 40 through the end, inclusive.

DIM Statement

Syntax: DIM *<list of subscripted variables>*

Purpose: To specify the maximum values for array variable subscripts and allocate storage accordingly.

Remarks: If an array variable name is used without a DIM statement, the maximum value of the array's subscript(s) is assumed to be 10. If a subscript is used that is greater than the maximum specified, a "Subscript out of range" error occurs. The minimum value for a subscript is 0, unless otherwise specified with the OPTION BASE statement.

The DIM statement sets all the elements of the specified numerical arrays to an initial value of zero and elements of string arrays to null strings.

Theoretically, the maximum number of dimensions allowed in a DIM statement is 255. In reality, however, that number would be impossible, since the name and punctuation are also counted as spaces on the line, and the line itself has a limit of 255 characters.

If the default dimension (10) has already been established for an array variable, and that variable is later encountered in a DIM statement, an "Array already dimensioned" error results. Therefore, it is good programming practice to put the required DIM statements at the beginning of a program, outside of any processing loops.

Example:

```
10 DIM A(20)
20 FOR I=0 TO 20
30  READ A(I)
40 NEXT I
.
.
.
```

DRAW Statement

Syntax: DRAW *<string expression>*

where *<string expression>* is one of the subcommands described below in "Remarks."

Purpose: To draw an object defined by the subcommands described below.

Remarks: The DRAW statement combines many of the capabilities of the other graphics statements into the Graphics Macro Language. The Graphics Macro Language defines a set of characteristics that comprehensively describe a particular image. In this case, the characteristics include motion (up, down, left, right), color, angle, and scale factor.

Each of the following subcommands initiates movement from the current graphics position. This is usually the coordinate of the last graphics point plotted with another GML command. The current position defaults to the center of the screen when a program is run.

Prefixes

The following prefix commands may precede any of the movement commands:

B Move but don't plot any points.

N Move but return to original position when done.

Cursor Movement

The following commands specify movement in units. The size of a unit may be modified by the S command. The default unit size is one point. If no argument is supplied, the cursor is moved one unit.

U [<*n*>] Move up (scale factor **n*) point ↑
D [<*n*>] Move down ↓
L [<*n*>] Move left ←
R [<*n*>] Move right →
E [<*n*>] Move diagonally up and right ↗
F [<*n*>] Move diagonally down and right ↘
G [<*n*>] Move diagonally down and left ↙
H [<*n*>] Move diagonally up and left ↖

Other Commands

M <*x,y*> Move absolute or relative. If x is preceded by a plus (+) or minus (−), x and y are added to the current graphics position and connected with the current position by a line. Otherwise, a line is drawn to point x,y from the current cursor position.

A <*n*> Set angle n. *n* may range from 0 to 3, where 0 is 0 degrees, 1 is 90, 2 is 180, and 3 is 270. Figures rotated 90 or 270 degrees are scaled so they will appear the same size as with 0 or 180 degrees on a monitor screen with the standard aspect ratio of 4/3.

TA <*n*> *n* must be in the range −360 to 360 degrees. If *n* is positive, rotation is counterclockwise. If *n* is negative, rotation is clockwise.

Example:

```
10 FOR D=0 TO 360 'Draw spokes
20 DRAW "TA=D;NU50"
30 NEXT D
```

C <*n*> Set color *n*.

S <*n*> Set scale factor. *n* may range from 1 to 255. The scale factor multiplied by the distances given with U, D, L, R, or relative M commands gives the actual distance traveled.

X <*string expression*>

Execute substring. This powerful command allows you to execute a second substring from a string, much like GOSUB in Microsoft BASIC. You can have one string execute another, which executes a third, and so on.

P <*paintcolor*>, <*bordercolor*>.

<*paintcolor*> is an integer paint attribute, and <*bordercolor*> is the integer border attribute. "Tile" painting is not supported in Draw.

Note: Numeric arguments can be constants like "123" or "=<*variable*>;" where <*variable*> is the name of a variable.

Examples 1:

```
DRAW "U50R50D50L50"     'Draw a box
DRAW "BE10"             'Move up and right
into box
DRAW "P1,3"             'Paint interior
```

```
10 U$ = "U30;"
20 D$ = "D30;"
30 L$ = "L40;"
40 R$ = "R40;"
50 BOX$ = U$ + R$ + D$ + L$
60 DRAW "XBOX$;"
```

The statement DRAW "XU$;XR$;XD$;XL$;" would have drawn the same box.

Example 2:

```
10 SCREEN 1,0
20 CLS
30 PA$ = "E30L15U15G15D30"
40 FOR I = 1 TO 3
50 I1 = 1*2
60 DRAW "C = I;S = I1;"
70 FOR J = 0 TO 3
80 J1 = J*90-45
90 DRAW "A = J;XPA$;TA = J1;XPA$;"
100 NEXT J,I
```

will draw a picture.

EDIT Command

Syntax: EDIT *<line number>*

Purpose: To edit the specified line.

Remarks: When EDIT is used, GW-BASIC types the specified program line and leaves the user in direct mode. The cursor is placed on the first digit of the line number.

See Chapter 4, "Writing Programs Using the GW-BASIC Editor," for full details on screen editing capabilities.

END Statement

Syntax: END

Purpose: To terminate program execution, close all files, and return to command level.

Remarks: END statements may be placed anywhere in the program to terminate execution. Unlike the STOP statement, END does not cause a "Break in line nn-nnn" message to be printed. An END statement at the end of a program is optional. Microsoft GW-BASIC always returns to command level after an END is executed.

Example:

```
520 IF K> 1000 THEN END ELSE GOTO 20
```

ENVIRON Statement

Syntax: ENVIRON <*string*>

Purpose: To modify a parameter in MS-DOS's Environment String Table.

Remarks: <*string*> is a string expression. The value of the expression must be of the form <*parameter-id*> = <*text*>, or <*parameter-id*> <*text*>. Everything to the left of the equal sign or space will be assumed to be a parameter, and everything to the right, text.

<*parameter-id*> and <*text*> must be specified with the capital letters.

If the parameter-id has not previously existed in the Environment String Table, it will be appended to the end of the table. If the parameter-id exists on the table when the ENVIRON statement is executed, the existing parameter-id is deleted and the new one appended to the end of the table.

The text string is the new parameter text. If the text is a null string (""), or consists only of a semicolon (";") then the existing parameter-id will be removed from the Environment String Table, and the remaining body of the file compressed.

This statement could be used to change the "PATH" parameter for a child process, or to pass parameters to a child by inventing a new Environment Parameter. (See the MS-DOS Utilities - PATH Command).

Errors include parameters that are not strings and an "out of memory" when no more space can be allocated to the Environment String Table. The amount of free space in the table will usually be quite small.

Example: The following MS-DOS command will create a default "PATH" to the root directory on DISK A:

```
PATH = A: \
```

The PATH may be changed to a new value by:

```
ENVIRON
"PATH = A:SALES;A:ACCOUNTING"
```

A new parameter may be added to the Environment String Table:

```
ENVIRON "SESAME = PLAN"
```

The Environment String Table now contains:

```
PATH = A:SALES;A:ACCOUNTING
SESAME = PLAN
```

If you then entered:

```
ENVIRON "SESAME = ;"
```

then you would have deleted SESAME, and you would have a table containing:

```
PATH = A:SALES;A:ACCOUNTING
```

Also see ENVIRON$ Function and SHELL Command respectively.

ENVIRON$ Function

Syntax: ENVIRON$ (<*sting parameter*>)
ENVIRON$ (<*n*>)

where *n* is an integer.

Purpose: To retrieve a parameter string from BASIC's Environment String Table.

Remarks: The string result returned by the ENVIRON$ function may not exceed 255 characters. If a parameter name is specified, and if it either cannot be found or it has no text following it, a null string is returned by ENVIRON$. When the parameter name is specified, ENVIRON$ returns all the associated text that follows "<*parameter*> = " in the Environment String Table.

If the argument is numeric, the nth string in the Environment String Table is returned. It includes all the text, including the parameter name. If the nth string does not exist, a null string is returned.

EOF Function

Syntax: EOF (<*file number*>)

Purpose: To test for the end-of-file condition.

Remarks: Returns −1 (true) if the end of a sequential file has been reached. Use EOF to test for end-of file while inputting, to avoid "Input past end" errors.

When EOF is used with random access files, it returns "true" if the last executed GET statement was unable to read an entire record because of an attempt to read beyond the end.

When EOF is used with a communications device, the definition of the end-of-file condition is dependent on the mode (ASCII or binary) that the device was opened in. In binary mode, EOF is true when the input queue is empty (LOC(n) = 0). It becomes false when the input queue is not empty. In ASCII mode, EOF is false until a Control-Z is received, and from then on it will remain true until the device is closed.

Example:

```
10 OPEN "I",1,"DATA"
20 C=0
30 IF EOF(1) THEN 100
40 INPUT #1,M(C)
50 C=C+1:GOTO 30
.
.
.
```

ERASE Statement

Syntax: ERASE <*list of array variables*>

Purpose: To eliminate arrays from memory.

Remarks: Arrays may be redimensioned after they are erased, or the previously allocated array space in memory may be used for other purposes. If an attempt is made to redimension an array without first erasing it, a "Duplicate definition" error occurs.

Example:

```
10 DIM B(1000)
.
.
450 ERASE A,B
460 DIM B(99)
.
.
.
```

ERDEV,ERDEV$ Functions

Syntax: ERDEV
ERDEV$

Purpose: To provide a way to obtain device-specific status information. ERDEV is an integer function which contains the error code returned by the last device to declare an error. ERDEV$ is a string function which contains the name of the Device Driver which generated the error.

Remarks: These functions may not be set by the programmer.

ERDEV is set by the Interrupt 24 Hex handler when an error within DOS is detected.

ERDEV will contain the INT 24 error code in the lower eight bits.

Example: If a user-installed Device Driver, "MYLPT2", ran out of paper, and the Driver's error number for that problem was "9":

```
PRINT ERDEV, ERDEV$
```

will yield

```
 9    MYLPT2
```

ERR And ERL Functions

Syntax: ERR
ERL

Remarks: When an error handling routine is entered, the function ERR contains the error code for the error and the function ERL contains the line number of the line in which the error was detected. The ERR and ERL functions are usually used in IF...THEN statements to direct program flow in the error handing routine.

With the GW-BASIC Interpreter, if the statement that caused the error was a direct mode statement, ERL will contain 65535.

If the line number is not on the right side of the relational operator, it cannot be renumbered with RENUM. Because ERL and ERR are reserved words, neither may appear to the left of the equal sign in a LET (assignment) statement. Microsoft GW-BASIC error codes are listed in Appendix A.

Example: To test whether an error occurred in a direct statement, the user could enter:

```
IF 65535 = ERL THEN PRINT "Direct Error"
```

When testing within a program, use:

IF ERR = *error code* **THEN ...**

IF ERL = *line number* **THEN ...**

ERROR Statement

Syntax: ERROR *<integer expression>*

Purpose: To simulate the occurrence of a BASIC error, or to allow error codes to be defined by the user.

Remarks: ERROR can be used as a statement (part of a program source line) or as a command (in direct mode).

The value of *<integer expression>* must be greater than 0 and less than 256. If the value of *<integer expression>* equals an error code already in use by BASIC (see Appendix A), the ERROR statement will simulate the occurrence of that error and the corresponding error message will be printed. (See Example 1.)

To define your own error code, use a value that is greater than any used by Microsoft GW-BASIC error codes. (It is preferable to use the highest available values, so compatibility may be maintained when more error codes are added to Microsoft GW-BASIC.) This user-defined error code may then be conveniently handled in an error handling routine. (See Example 2.)

If an ERROR statement specifies a code for which no error message has been defined, Microsoft GW-BASIC responds with the "Unprintable error" error message. Execution of an ERROR statement for which there is no error handling routine causes an error message to be printed and execution to halt.

Example 1:

```
20 S = 15
30 ERROR S
40 END
```

will yield

String too long in line 30

Or, in direct mode (interpreter only):

```
Ok
ERROR 15        (You type this line.)
String too long (GW-BASIC types this line.)
Ok
```

Example 2:

```
.
.
.
110 ON ERROR GOTO 400
120 INPUT "WHAT IS YOUR BET";B
130 IF B > 5000 THEN ERROR 210
.
.
.
400 IF ERR = 210 THEN PRINT "HOUSE LIMIT
IS $5000"
410 IF ERL = 130 THEN RESUME 120
.
.
.
```

EXP Function

Syntax: EXP (*x*)

Purpose: To return e (base of natural logarithms) to the power of x. *x* must be $< = 88.02969$.

Remarks: If *x* is greater than 88.02969, the "Overflow" error message is displayed, machine infinity with the appropriate sign is supplied as the result, and execution continues.

The EXP function will return a single precision value unless the /D switch was used when BASIC was invoked and a double precision variable is used as the argument.

Example:

```
10 X = 5
20 PRINT EXP(X - 1)
```

will yield

```
 54.59815
```

FIELD Statement

Syntax: FIELD [#]<*file number*>,<*field width*> AS <*string variable*>...

Purpose: To allocate space for variables in a random file buffer.

Remarks: Before a GET statement or PUT statement can be executed, a FIELD statement must be executed to format the random file buffer.

<*file number*> is the number under which the file was opened. <*field width*> is the number of characters to be allocated to <*string variable*>.

The total number of bytes allocated in a FIELD statement must not exceed the record length that was specified when the file was opened. Otherwise, a "Field overflow" error occurs. (The default record length is 128 bytes.)

Any number of FIELD statements may be executed for the same file. All FIELD statements that have been executed will remain in effect at the same time.

Note: *Do not use a fielded variable name in an INPUT or LET statement.* Once a variable name is fielded, it points to the correct place in the random file buffer. If a subsequent INPUT or LET statement with that variable name is executed, the variable no longer refers to the random file record buffer, but to the variables stored in string space.

Example 1: FILED 1,20 AS N$,10 AS ID$, 40 AS ADD$

Allocates the first 20 bytes in the random file buffer to the string variable N$, the next 10 bytes to ID$, and the next 40 to ADD$. FIELD does not place any data in the random file buffer. (See also GET Statement and LSET and RSET Statements.)

Example 2:

```
10 OPEN "R,"#1,"A:PHONELST",35
15 FIELD #1,2 AS RECNBR$,33 AS DUMMY$
20 FIELD #1,25 AS NAMES,10 AS
PHONENBR$
25 GET #1
30 TOTAL=CVI(RECNBR)$
35 FOR I=2 TO TOTAL
40  GET #1, I
45  PRINT NAMES, PHONENBR$
50 NEXT I
```

Illustrates a multiple defined FIELD statement. In statement 15, the 35-byte field is defined for the first record to keep track of the number of records in the file. In the next loop of statements (35-50), statement 20 defines the field for individual names and phone numbers.

Example 3:

```
10 FOR LOOP%=0 TO 7
20 FIELD #1,(LOOP%*16) AS OFFSET$,16 AS
A$(LOOP%)
30 NEXT LOOP%
```

Shows the construction of a FIELD statement using an array of elements of equal size. The result is equivalent to the single declaration:

```
FIELD #1,16 AS A$(0),16 AS A$(1),...,16 AS
A$(6),16 AS A$(7)
```

Example 4:

```
10 DIM SIZE% (4%): REM ARRAY OF FIELD
SIZES
20 FOR LOOP% = 0 TO 4%
30 READ SIZE% (LOOP%)
40 NEXT LOOP%
50 DATA 9,10,12,21,41
.
.
.
120 DIM A$(4%): REM ARRAY OF FIELDED
VARIABLES
130 OFFSET% = 0
140 FOR LOOP% = 0 TO 4%
150 FIELD #1,OFFSET% AS OFFSET$,
SIZE%(LOOP%) AS A$(LOOP%)
160 OFFSET% = OFFSET% + SIZE%(LOOP%)
170 NEXT LOOP%
```

Creates a field in the same manner as Example 3. However, the element size varies with each element. The equivalent declaration is:

```
FIELD #1,SIZE%(0) AS A$(0),SIZE%(1) AS
A$(1),...
SIZE%(4%) AS A$(4%)
```

FILES Statement

Syntax: FILES [<*filespec*>]

where <*filespec*> includes either a filename or a pathname and optional device designation.

Purpose: To print the names of files residing on the specified disk.

Remarks: If <*filespec*> is omitted, all the files on the currently selected drive will be listed. <*filespec*> is a string formula which may contain question marks (?) or asterisks (*) used as wild cards. A question mark will match any single character in the filename or extension. An asterisk will match one or more characters starting at that position. The asterisk is a shorthand notation for a series of question marks. The asterisk need not be used in the case where all the files on a drive are requested, e.g., FILES "B:"

If a filespec is used, and no explicit path is given, the current directory is the default.

Examples: FILES

Shows all files on the current directory.

FILES "*.BAS"

Shows all files with extension .BAS.

FILES "B:*.*"

Shows all files on drive B.

FILES "B:" (equivalent to "B:*.*")

FILES "TEST?.BAS"

Shows all five-letter files whose names start with "TEST" and end with the .BAS extension.

FILES " \ SALES"

If SALES is a subdirectory of the current directory, this statement displays SALES <dir>. If SALES is a file in the current directory, this statement displays SALES.

FILES " \ SALES \ MARY"

Displays MARY <dir> if MARY is a subdirectory of SALES or if MARY is a file, displays its name.

FIX Function

Syntax: FIX (*x*)

Purpose: To return the truncated integer part of *x*.

Remarks: FIX (*x*) is equivalent to SGN(x) *INT(ABS(x)). The difference between FIX and INT is that FIX does not return the next lower number for negative x.

Examples:

```
PRINT FIX (58.75)
```

will yield

```
 58
```

```
PRINT FIX (-58.75)
```

will yield

```
-58
```

FOR...NEXT Statement

Syntax:

FOR <*variable*> = *x* TO *y* [STEP *z*]

.

.

.

NEXT [<*variable*>] [,<*variable*>...]

where *x*, *y*, and *z* are numeric expressions.

Purpose:

To allow a series of instructions to be performed in a loop a given number of times.

Remarks:

<*variable*> is used as a counter. The first numeric expression (*x*) is the initial value of the counter. The second numeric expression (*y*) is the final value of the counter. The program lines following the FOR statement are executed until the NEXT statement is encountered. Then the counter is adjusted by the amount specified by STEP. A check is performed to see if the value of the counter is now greater than the final value (*y*). If it is not greater, GW-BASIC branches back to the statement after the FOR statement and the process is repeated. If it is greater, execution continues with the statement following the NEXT statement. This is a FOR...NEXT loop.

If STEP is not specified, the increment is assumed to be one. If STEP is negative, the final value of the counter is set to be less than the initial value. The counter is decreased each time through the loop. The loop is executed until the counter is less than the final value.

The counter must be an integer or single precision numeric constant. If a double precision numeric constant is used, a "Type mismatch" error will result.

The body of the loop is skipped if the initial value of the loop times the sign of the STEP exceeds the final value times the sign of the STEP.

Nested Loops

FOR...NEXT loops may be nested; that is, a FOR...NEXT loop may be placed within the context of another FOR...NEXT loop. When loops are nested, each loop must have a unique variable name as its counter. The NEXT statement for the inside loop must appear before that for the outside loop. If nested loops have the same end point, a single NEXT statement may be used for all of them.

The variable(s) in the NEXT statement may be omitted, in which case the NEXT statement will match the most recent FOR statement. If a NEXT statement is encountered before its corresponding FOR statement, a "NEXT without FOR" error message is issued and execution is terminated.

Example 1:

```
10 K = 10
20 FOR I = 1 TO 10 STEP 2
30 PRINT I;
40 LET K = K + 10
50 PRINT K
60 NEXT I
```

will yield

```
 1  20
 3  30
 5  40
 7  50
 9  60
```

In this example, the loop counter, I, advances +2 on each cycle. The loop prints the counter, increments K, and prints K.

Example 2:

```
10 J = 0
20 FOR I = 1 TO J
30 PRINT I
40 NEXT I
```

In this example, the loop does not execute because the initial value of the loop exceeds the final value.

Example 3:

```
10 I = 5
20 FOR I = 1 TO I + 5
30  PRINT I;
40 NEXT I
```

will yield

```
 1  2  3  4  5  6  7  8  9  10
```

In this example, the loop executes ten times. The final value for the loop variable is always set before the initial value is set.

FRE Function

Syntax: FRE (0)
FRE("")

Purpose: With a numeric argument, FRE returns the number of bytes in memory that are not being used by Microsoft GW-BASIC. Arguments to FRE are dummy arguments.

FRE("") forces a garbage collection before returning the number of free bytes.

Remarks: GW-BASIC will not initiate garbage collection until all free memory has been used up. Therefore, using FRE("") periodically will result in shorter delays for each garbage collection.

Example:

```
PRINT FRE (0)
```

might yield

```
 14542
```

GET Statement (File I/O)

Syntax: GET [#]<*file number*>[,<*record number*>]

Purpose: To read a record from a random disk file into a random buffer.

Remarks: <*file number*> is the number under which the file was OPENed. If <*record number*> is omitted, the next record (after the last GET) is read into the buffer.

The GET and PUT statements allow fixed-length input and output for GW-BASIC COM files. However, because of the low performance associated with telephone line communications, we recommend that you do not use GET and PUT for telephone communication.

Example:

```
10 OPEN "R", #1,"PHONE.DAT",20
20 FIELD #1,12 AS NAME1$", 8 AS PHONENO$

.
.
100 I = 10
110 GET #1,I
120 PRINT NAME1$, PHONENO$
```

Note: After a GET statement has been executed, INPUT# and LINE INPUT# may be executed to read characters from the random file buffer. The EOF function may be used after a GET statement to see if that GET was beyond the end of file marker.

GET Statement (Graphics)

Syntax: GET (*x1,y1*)–(*x2,y2*),<*array name*>

used with

PUT (*x1,y1*),<*array name*>[,*action verb*]

Purpose: The GET and PUT statements are used together to transfer graphic images to and from the screen.

The GET statement transfers the screen image bounded by the rectangle described by the specified points into the array.

The PUT statement transfers the image stored in the array onto the screen.

Where (*x1,y1*)-(*x2,y2*) is a rectangular area on the display screen. The rectangle is defined with (*x1,y1*) and (*x2,y2*) being the upper-left and the lower-right vertices.

<*array name*> is the name assigned to the place that will hold the image. The array can be any type except string. It must be dimensioned large enough to hold the entire image. Required size of array is calculated as follows:

<array size> =
(4 + INT((X*M + 7)/8)*Y + A – 1)/A

where

X: the number of horizontal dots
Y: the number of vertical dots
A: the number of bytes in the array element
M = 1: high resolution mode
M = 2: medium resolution mode

For example, the number of bytes required to make a 15 by 20 image in medium resolution would be calculated as:

```
4 + INT((15*2 + 7)/8)*20
```

or in other words, 44. The number of bytes per array element depends on the precision used. The following rules apply:

2 bytes for an integer
4 bytes for single precision
8 bytes for double precision

An integer array would thus have 22 elements.

Remarks: One of the most useful things that can be done with GET and PUT is animation. (See PUT Statement discussion of animation.)

Example:

```
100 SCREEN 1
110 FOR I=1 TO 10
120    LINE (0,0)-
(RND*319, RND*199), RND*2+1
130 NEXT
140 FOR I = 1 TO 10
150    LINE (319,199)-
(RND*319,RND*199), RND*2+1
160 NEXT
170 DIM A% (128)
180 GET (100,100)-(110,120),A%
190 END
```

GOSUB...RETURN Statements

Syntax: GOSUB <*line number*>

.

RETURN [<*line number*>]

Purpose: To branch to, and return from, a subroutine.

Remarks: <*line number*> in the GOSUB statement is the first line of the subroutine.

A subroutine may be called any number of times in a program. A subroutine also may be called from within another subroutine. Such nesting of subroutines is limited only by available memory.

Simple RETURN statement(s) in a subroutine cause Microsoft GW-BASIC to branch back to the statement following the most recent GOSUB statement. A subroutine may contain more than one RETURN statement.

The <*line number*> option may be included in the RETURN statement to return to a specific line number from the subroutine. Use this type of return with care, however, because any other GOSUBs, WHILEs, or FORs that were active at the time of the GOSUB will remain active, and errors such as "FOR without NEXT" may result.

Subroutines may appear anywhere in the program, but it is recommended that the subroutine be readily distinguishable from the main program. To prevent inadvertent entry into the subroutine, precede it with a STOP, END, or GOTO statement that directs program control around the subroutine.

Example:

```
10 GOSUB 40
20 PRINT "BACK FROM SUBROUTINE"
30 END
40 PRINT "SUBROUTINE";
50 PRINT " IN";
60 PRINT " PROGRESS"
70 RETURN
```

will yield

```
SUBROUTINE IN PROGRESS
BACK FROM SUBROUTINE
```

GOTO Statement

Syntax: GOTO *<line number>*

Purpose: To branch unconditionally to a specified line number.

Remarks: If *<line number>* is an executable statement, that statement and those following are executed. If it is a nonexecutable statement, execution proceeds at the first executable statement encountered after *<line number>*.

Example:

```
10 READ R
20 PRINT "R = ";R,
30 A = 3.14*R^2
40 PRINT "AREA = ";A
50 GOTO 10
60 DATA 5,7,12
```

will yield

```
R = 5          AREA = 78.5
R = 7          AREA = 153.86
R = 12         AREA = 452.16
Out of DATA in 10
```

HEX$ Function

Syntax: HEX$ (*x*)

Purpose: To return a string that represents the hexadecimal value of the decimal argument.

Remarks: *x* is rounded to an integer before HEX$(*x*) is evaluated.

Example:

```
10 INPUT X
20 A$ = HEX$(X)
30 PRINT X "DECIMAL IS" A$
"HEXADECIMAL"
```

will yield

```
? 32
 32 DECIMAL IS 20 HEXADECIMAL
```

See the OCT$ function for details on octal conversion.

IF...THEN[...ELSE]/ IF...GOTO Statements

Syntax: IF <*expression*>[,] THEN {<*statement(s)*>|<*line number*>}

[,[ELSE{<*statement(s)*>|<*line number*>}]]

Syntax: IF <*expression*>[,] GOTO <*line number*>

[,[ELSE {<*statement(s)*>|<*line number*>}]]

Purpose: To make a decision regarding program flow based on the result returned by an expression.

Remarks: If the result of <*expression*> is not zero, the THEN or GOTO clause is executed. THEN may be followed by either a line number for branching or one or more statements to be executed. GOTO is always followed by a line number. If the result of <*expression*> is zero, the THEN or GOTO clause is ignored and the ELSE clause, if present, is executed. Execution continues with the next executable statement. A comma is allowed before THEN.

Nesting of IF Statements

IF...THEN...ELSE statements may be nested. Nesting is limited only by the length of the line. For example,

```
IF X>Y THEN PRINT "GREATER" ELSE IF
X<Y THEN PRINT "LESS THAN" ELSE
PRINT "EQUAL"
```

is a legal statement. If the statement does not contain the same number of ELSE and THEN clauses, each ELSE is matched with the closest unmatched THEN. For example

```
IF A=B THEN IF B=C THEN PRINT "A=C"
    ELSE PRINT "A<>C"
```

will not print "A< >C" when A< >B.

If an IF...THEN statement is followed by a line number in direct mode, an "Undefined line" error results, unless a statement with the specified line number had previously been entered in indirect mode.

Note: When using IF to test equality for a value that is the result of a floating-point computation, remember that the internal representation of the value may not be exact. Therefore, the test should be against the range over which the accuracy of the value may vary. For example, to test a computed variable A against the value 1.0, use:

```
IF ABS (A-1.0)<1.0E-6 THEN ...
```

This test returns true if the value of A is 1.0 with a relative error of less than 1.0E-6.

Example 1:

```
200 IF I THEN GET#1,I
```

This statement GETs record number I if I is not zero.

Example 2:

```
100 IF(I<20)*(I>10) THEN DB=1979-1:GOTO
300
110 PRINT "OUT OF RANGE"
.
.
.
```

In this example, a test determines if I is greater than 10 and less than 20. If I is in this range, DB is calculated and execution branches to line 300. If I is not in this range, execution continues with line 110.

Example 3: 210 IF IOFLAG THEN PRINT A$ ELSE LPRINT A$

This statement causes printed output to go either to the screen or the line printer, depending on the value of the variable IOFLAG. If IOFLAG is zero, output goes to the line printer; otherwise, output goes to the screen.

INKEY$ Function

Syntax: INKEY$

Purpose: To return either a one-character string containing a character read from the standard input device or a null string if no character is pending there. The keyboard is usually the standard input device.

Remarks: No characters will be echoed. All characters are passed through to the program except for Break, which terminates the program.

Example:

```
1000 'TIMED INPUT SUBROUTINE
1010 RESPONSE$ = ""
1020 FOR I% = 1 TO TIMELIMIT%
1030 A$ = INKEY$
1035 IF LEN(A$) = 0 THEN 1060
1040 IF ASC(A$) = 13 THEN TIMEOUT% = 0
1045 IF TIMEOUT% = 0 THEN RETURN
1050 RESPONSE$ = RESPONSE$ + A$
1060 NEXT I%
1070 TIMEOUT% = 1 : RETURN
```

Note: Some keys may return a two-byte string, depending on your implementation.

Example:

```
190 'Wait until any key is pressed
200 X$ = INKEY$
210 IF X$ = "" THEN 200
220 'Next process
```

In this example, line number 200 and 210 will be executed infinitely until any key is pressed.

INP Function

Syntax: INP (*i*)

Purpose: To return the byte read from port i. *i* must be in the range 0 to 65535.

Remarks: INP is the complementary function to the OUT statement.

Example:

```
100 A = INP(54321)
```

In 8086 assembly language, this is equivalent to:

```
MOV DX,54321
IN AL,DX
```

INPUT Statement

Syntax: INPUT [;] [<"*prompt string*">;]<*variable list*>

Purpose: To allow input from the keyboard during program execution.

Remarks: When an INPUT statement is encountered, program execution pauses and a question mark is printed to indicate the program is waiting for data. If <"*prompt string*"> is included, the string is printed before the question mark. The required data is then entered at the keyboard.

BASIC can be re-directed to read from standard input and write to standard output by providing the input and output filenames when invoking BASIC. (See Section 2.1, "Invoking BASIC.")

A comma may be used instead of a semicolon after the prompt string to suppress the question mark. For example, the statement INPUT "ENTER BIRTHDATY",B$ will print the prompt with no question mark.

If INPUT is immediately followed by a semicolon, then the carriage return typed by the user to input data does not echo a carriage return/linefeed sequence.

The data that is entered is assigned to the variable(s) given in <*variable list*>. The number of data items supplied must be the same as the number of variables in the list. Data items are separated by commas.

The variable names in the list may be numeric of string variable names (including subscripted variables). The type of each data item that is input must agree with the type specified by the variable name. (Strings input to an INPUT statement need not be surrounded by quotation marks.)

Responding to INPUT with too many or too few items or with the wrong type of value (numeric instead of string, etc.) causes the message "?Redo from start" to be printed. No assignment of input values is made until an acceptable response is given.

Examples:

```
10 INPUT X
20 PRINT X; "SQUARED IS";X^2
30 END
```

will yield

? 5 (The 5 was typed in by the user in response to the question mark.)

```
 5 SQUARED IS 25
```

```
10 PI = 3.14
20 INPUT "WHAT IS THE RADIUS";R
30 A = PI*R^2
40 PRINT "THE AREA OF THE CIRCLE IS";A
50 PRINT
60 GOTO 20
```

will yield

```
WHAT IS THE RADIUS? 7.4
```
(User types 7.4)

```
THE AREA OF THE CIRCLE IS 171.9464

WHAT IS THE RADIUS?
```
etc.

INPUT # Statement

Syntax: INPUT # <*file number*>,<*variable list*>

Purpose: To read data items from a sequential device or file and assign them to program variables.

Remarks: <*file number*> is the number used if the file has been OPENed for input. <*variable list*> contains the variable names that will be assigned to the items in the file. (The variable type must match the type specified by the variable name.) With INPUT #, no question mark is printed, as with INPUT.

The data items in the file should appear just as they would if data were being typed in response to an INPUT statement. With numeric values, leading spaces, carriage returns, and linefeeds are ignored. The first character encountered that is not a space, carriage return, or linefeed is assumed to be the start of a number. The number terminates on a space, carriage return, linefeed, or comma.

If GW-BASIC is scanning the sequential data file for a string item, it will also ignore leading spaces, carriage returns, and linefeeds. The first character encountered that is not a space, carriage return, or linefeed is assumed to be the start of a string item. If this first character is a quotation mark ("), the string item will consist of all characters read between the first quotation mark and the second. Thus, a quoted string may not contain a quotation mark as a character. If the first character of the string is not a quotation mark, the string is an unquoted string, and will terminate on a comma, carriage return, or linefeed (or after 255 characters have been read). If end-of-file is reached when a numeric or string item is being INPUT, the item is terminated.

Example:

```
INPUT #2,A,B,C
```

INPUT$ Function

Syntax: INPUT$ (*x*[,[#]*y*])

Purpose: To return a string of x characters, read from file number y. If the file number is not specified, the characters will be read from the standard input device. (If input has not been redirected, the keyboard is the standard input device).

Remarks: If the keyboard is used for input, no characters will be echoed on the screen. All control characters are passed through except Break which is used to interrupt the execution of the INPUT$ function.

BASIC can be re-directed to read from standard input by providing the input filename on the command line. (See Section 2.1,"Invoking BASIC.")

Example 1:

```
 5 'LIST THE CONTENTS OF A SEQUENTIAL
FILE IN HEXADECIMAL
10 OPEN"I",1,"DATA"
20 IF EOF(1) THEN 50
30 PRINT HEX$(ASC(INPUT$(1,#1)));
40 GOTO 20
50 PRINT
60 END
```

Example 2:

```
.
.
.
100 PRINT "TYPE P TO PROCEED OR S TO
STOP"
110 X$=INPUT$(1)
120 IF X$="P" THEN 500
130 IF X$="S" THEN 700 ELSE 100
.
.
.
```

INSTR Function

Syntax: INSTR ([*i*,]x$,*y$*)

Purpose: To search for the first occurrence of string *y$* in *x$*, and to return the position at which the match is found. Optional offset *i* sets the position for starting the search.

Remarks: *i* must be in the range 1 to 255. If i is greater than the number of characters in *x$* (LEN(x$)), or if *x$* is null or *y$* cannot be found, INSTR returns 0. If *y$* is null, INSTR returns i or 1, and then if no i has been specified, INSTR returns 1. *x$* and *y$* may be string variables, string expressions, or string literals.

Example:

```
10 X$ = "ABCDEB"
20 Y$ = "B"
30 PRINT INSTR(X$,Y$);INSTR(4,X$,Y$)
```

will yield

```
 2  6
```

INT Function

Syntax: INT (*x*)

Purpose: To return the largest integer $<=x$.

Examples: PRINT INT (99.89)

will yield

99

PRINT INT(−12.11)

will yield

−13

See the CINT and FIX functions which also return integer values.

IOCTL Statement

Syntax: IOCTL [#] <*filenumber*>, <*string*>

Purpose: To transmit a control character or string to a device driver.

Remarks: IOCTL commands are generally two to three characters followed optionally by an alphanumeric argument. An IOCTL$ command string may be up to 255 bytes long.

The IOCTL statement works only if:

1. The device driver is installed.
2. The device driver states it processes IOCTL strings.
3. BASIC performs an OPEN on a file on that device.

Most standard MS-DOS device drivers don't process IOCTL strings, and it is necessary for the programmer to determine whether the specific driver can handle the command.

Example: If a user wanted to set the page length to 66 lines per page on LPT1, the procedure might be:

```
10 OPEN "\DEV\LPT1" FOR OUTPUT AS #1
20 IOCTL #1, "PL66"
```

Also see the IOCTL$ Function.

IOCTL$ Function

Syntax: IOCTL$ ([#] <*filenumber*>)

Purpose: To receive a control data string from a device driver.

Remarks: The IOCTL$ function is most frequently used to receive acknowledgement that an IOCTL statement succeeded or failed, or to obtain current status information.

IOCTL$ could be used to ask a communications device to return the current baud rate, information on the last error, logical line width, etc.

The IOCTL$ function works only if:.

1. The device driver is installed.
2. The device driver states it processes IOCTL strings.
3. BASIC performs an OPEN on a file on that device.

Example:

```
10 OPEN "\DEV\FOO" AS #1
20 IOCTL #1, "RAW"
```

This example tells the device that the data is raw.

```
30 IF IOCTL$ (1)="0" THEN CLOSE 1
```

In this continuation, if the Character Driver 'FOO' responds 'false' from the raw data mode IOCTL statement, then the file is closed.

Also see the IOCTL Statement.

KEY Statement

Syntax:

KEY *n*, *x$*
KEY LIST
KEY ON
KEY OFF

n is the number of the function key.

x$ is the text assigned to the specified key.

Purpose:

To assign softkey values to function keys and display the values.

Remarks:

The KEY statement allows function keys to be designated for special "softkey" functions. Each of the function keys may be assigned a 15-byte string which will be input to GW-BASIC when that key is pressed.

Softkeys can be displayed with the KEY ON, KEY OFF, and KEY LIST statements.

KEY ON causes the softkey values to be displayed on the bottom line of the screen.

KEY OFF erases the softkey display from the bottom line, making that line available for program use. It does not disable the function keys.

KEY LIST displays all softkey values on the screen, with all 15 characters of each key displayed.

Assigning a null string (string of length 0) to a softkey disables the function key as a softkey.

If the function key number is not in the range of permissible function key numbers, an "Illegal function call" error is produced, and the previous key string expression is retained.

When a softkey is assigned, the INKEY$ function returns one character of the softkey string per invocation.

Example:

```
50 KEY ON 'Displays the softkey on bottom line
60 KEY OFF 'Erases softkey display
70 KEY 1, "MENU" + CHR$(13)'
```

Assigns the string "MENU" followed by a carriage return to softkey 1.

Such assignments might be used to speed data entry.

```
80 KEY 1,"" 'Disables softkey 1
```

The following routine initializes the first five softkeys:

```
10 KEY OFF 'Turns off key display during
initialization
20 DATA "EDIT","LET",
"SYSTEM","PRINT","LPRINT"
30 FOR I = 1 TO 5
40 READ SOFTKEYS$(I)
50 KEY I,SOFTKEYS$(I)
60 NEXT I
70 KEY ON 'Displays new softkeys
```

KEY(n) Statement

Saxtax: KEY (*n*) ON
KEY (*n*) OFF
KEY (*n*) STOP

Purpose: To enable or disable event trapping of softkey cursor direction, key, or user-defined key activity for the specified trappable key.

Where (*n*) is the number of a function key, a user-defined key, or cursor direction key. (See KEY Statement for information on assigning softkey values to function keys). The cursor direction keys are numbered sequentially after the function keys in the following order: up, left, right, down; then come the user-defined keys.

1 through 10: F1 through F10
11 through 14: cursor control keys
15 through 20: user-defined keys

User Defined keys are defined by the statement:

KEY *i*, CHR$ (*j*) + CHR$(*k*)

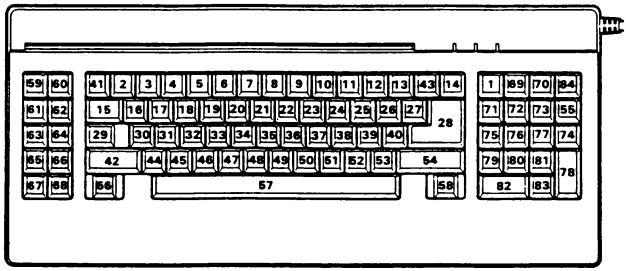
where *i* is the user key number (15 through 20), *j*, the shift status, and *k*, the key scan-code.

The shift status is defined as follows:

Caps Lock:	64
Num Lock:	32
Alt:	8
Ctrl:	4
Shift:	1 or 2 or 3

The key scan-code is the unique code which represents each key. These codes are shown below:

Scan-code:



For example, Ctrl-C key can be defined as user-defined key number 15 follows:

```
KEY 15,CHR$(4) + CHR$(46)
```

Remarks: Note that the KEY Statement described in the previous section assigns softkey values to function keys and displays the values. Do not confuse KEY ON and KEY OFF, which display and erase these values, with the event trapping statements described in this section.

The KEY (*n*) On Statement enables softkey or cursor direction key event rapping by an ON KEY Statement (see On KEY Statement). While trapping is enabled, and if a non-zero line number is specified in the ON KEY Statement, BASIC checks between every statement to see if a softkey or cursor direction key has been used. If it has, the ON KEY Statement is executed. The text that would normally be associated with a function key will not be printed.

Note: For additional information on key event trapping, see "Event Trapping", Section 6.2, and "ON KEY Statement".

Example:

```
20 KEY (4) ON 'enables event trapping
.
.
.
70 ON KEY (4) GOSUB 200
.
.
.

F4 pressed
.
.
.
200 'Subroutine for F4
```

KILL Statement

Syntax: KILL [<*filespec*>]

Purpose: To delete a file or a pathname from disk.

Remarks: If a KILL statement is given for a file that is currently open, a "File already open" error occurs.

KILL is used for all types of disk files: program files, random data files, and sequential data files. The filespec may contain question marks (?) or asterisks (*) used as wildcards. A question mark will match any single character in the filename or extension. An asterisk will match one or more characters starting at its position.

Since it is possible to reference the same file in a sub-directory via different paths, it is nearly impossible for BASIC to know that it is indeed the same file simply by looking at the path. For example; if MARY is your current directory, then:

```
"REPORT"...
" \ SALES \ MARY \ REPORT"...
".. \ MARY \ REPORT"...
".. \ .. \ MARY \ REPORT"...
```

all refer to the same file. Therefore, any open file with the same file name will cause a "file already open" error.

WARNING

Be extremely careful when using wildcards with this command.

Examples: 200 KILL "DATA1?.DAT"

The position taken by the question mark will match any valid filename character. This command will kill any file that has a six character name starting with "DATA1" and has the filename extension ".DAT". This includes "DATA10.DAT" and "DATA1Z.DAT".

210 KILL "DATA1.*"

Kills all files named DATA1, regardless of the filename extension.

220 KILL ".. \ GREG \ *.DAT"

Kills all files with the extension ".DAT" in a directory called GREG.

LEFT$ Function

Syntax: LEFT$ (<*string*>, *i*)

Purpose: To return a string comprising the leftmost i characters of <*string*>.

Remarks: *i* must be in the range 0 to 255. If *i* is greater than the number of characters in <*string*>, (LEN(X$)), the entire string (<*string*>) will be returned. If *i* = 0, the null string (length zero) is returned.

Example:

```
10 A$ = "BASIC LANGUAGE"
20 B$ = LEFT$(A$,5)
30 PRINT B$
```

will yield

```
BASIC
```

Also see the MID$ and RIGHT$ functions.

LEN Function

Syntax: LEN (<*string*>)

Purpose: To return the number of characters in <*string*>. Nonprinting characters and blanks are counted.

Example:

```
10 X$ = "PORTLAND, OREGON"
20 PRINT LEN(X$)
```

will yield

```
 15
```

LET Statement

Syntax: LET <*variable*> = <*expression*>

Purpose: To assign the value of an expression to a variable.

Remarks: Notice that the word LET is optional; i.e., the equal sign is sufficient for assigning an expression to a variable name.

Example:

```
110 LET D = 12
120 LET E = 12^2
130 LET F = 12^4
140 LET SUM = D + E + F
.
.
.
```

or

```
110 D = 12
120 E = 12^2
130 F = 12^4
140 SUM = D + E + F
.
.
.
```

LINE Statement

Syntax: LINE [[STEP](*x1,y1*)]-[STEP](*x2,y2*) [,[<*color*>] [,B[F]] [,<*style*>]]]

(*x1,y1*) is the coordinate for the starting point of the line.

(*x2,y2*) is the ending point for the line.

The [STEP] option makes the specified coordinates relative to the "most recent point", instead of absolute, mapped coordinates.

<*color*> is the number of the color in which the line should be drawn. (See COLOR statement.) If the ,b or ,bf option is used, the box is drawn in this color.

B draws a box with the points (*x1,y1*) and (*x2,y2*) specifying the upper left and lower right corners.

BF draws a filled box.

<*style*> is a 16-bit integer mask used when putting pixels down on the screen. This is called "line styling".

Purpose: To draw a line or box on the screen.

Remarks: When coordinates specify a point that is not in the current viewport, the line segment is clipped to the viewport.

The relative coordinate form STEP (<*xoffset*>,<*yoffset*>) may be used instead of an absolute coordinate. For example, assume that the last point referenced was (10,10). The statement LINE STEP (10,5) would specify a point at offset 10 from x and offset 5 from y; that is, (20,15).

If the STEP option is used for the second coordinate on a LINE statement, it is relative to the first coordinate in the statement. Other ways to establish a new "most recent point" are to initialize the screen with the CLS and SCREEN statements. Using the PSET, PRESET, CIRCLE and DRAW statements will establish a new "most recent point"

Each time LINE stores a point on the screen, it uses the current circulating bit in [*style*]. If that bit is a 0, then no storing will be done; if the bit is a 1, the point is stored. After each point is stored, the next bit position in [*style*] is selected. Since a 0 bit in [*style*] causes no change to the point on the screen, the user may prefer to draw a background line before a 'styled' line in order to force a known background. Style is used for normal lines and boxes, but has no effect on filled boxes.

Examples: The following examples assume a screen 320 pixels wide by 200 pixels high.

```
10 LINE -(x2,y2)
```

Draws a line from the last point to x2,y2 in the foreground color.

```
20 LINE (0,0)-(319,199)
```

Draws a diagonal line across the screen (downward).

```
30 LINE (0,100)-(319,100)
```

Draws a line across the screen.

```
40 LINE (10,10)-(20,20),2
```

Draws a line in color 2.

```
10 FOR X = 0 to 319
20 LINE (X,0) – (X,199), X AND 1
30 NEXT
```

Draws an alternating line on-line off pattern on a monochrome display.

```
10 LINE (0,0) – (100,100),,B
```

Draws a box in the foreground (note that the color is not included).

```
20 LINE STEP (0,0) – STEP (200,100),2,BF
```

Draws a filled box in color 2. Coordinates are given as offsets.

```
10 LINE (0,0) – (160,100),3,,&HFF00
```

Draws a dashed line from the upper left hand corner to the center of the screen.

LINE INPUT Statement

Syntax: LINE INPUT [;] [<*"prompt string"*>;] <*string variable*>

Purpose: To input an entire line (up to 255 characters) to a string variable, without the use of delimiters.

Remarks: <*"prompt string"*> is a string literal that is printed at the terminal before input is accepted. A question mark is not printed unless it is part of <*"prompt string"*>. All input from the end of <*"prompt string"*> to the carriage return is assigned to <*string variable*>. However, if a linefeed/carriage return sequence (this order only) is encountered, both characters are echoed; but the carriage return is ignored, the linefeed is put into <*string variable*>, and data input continues.

If LINE INPUT is immediately followed by a semicolon, then the carriage return typed by the user to end the input line does not echo a carriage return/linefeed sequence at the terminal.]

A LINE INPUT statement may be aborted by typing Control-C. GW-BASIC will return to command level. If you are using the interpreter, typing CONT resumes execution at the LINE INPUT.

Example: See LINE INPUT # Statement.

LINE INPUT # Statement

Syntax: LINE INPUT # <*file number*>,<*string variable*>

Purpose: To read an entire line (up to 255 characters), without delimiters, from a sequential disk data file to a string variable.

Remarks: <*file number*> is the number under which the file was OPENed. <*string variable*> is the variable name to which the line will be assigned. LINE INPUT # reads all characters in the sequential file up to a carriage return. It then skips over the carriage return/linefeed sequence. The next LINE INPUT # reads all characters up to the next carriage return. (If a linefeed/carriage return sequence is encountered, it is preserved.)

LINE INPUT # is especially useful if each line of a data file has been broken into fields, or if GW-BASIC program saved in ASCII format is being read as data by another program. (See SAVE Command.)

When GW-BASIC is invoked with redirected input and output, all LINE INPUT statements will read from the input file specified instead of the keyboard.

When input is redirected, GW-BASIC will continue to read from this source until a control-Z is detected. This condition may be tested with the EOF function. If the file is not terminated by a CONTROL-Z, or a BASIC file input statement tries to read past end-of-file, then any open files are closed, the message "Read past end" is written to standard output, and BASIC returns to MS-DOS.

Example:

```
10 OPEN "O", 1,"LIST"
20 LINE INPUT "CUSTOMER
INFORMATION? ";C$
30 PRINT #1, C$
40 CLOSE 1
50 OPEN "I",1,"LIST"
60 LINE INPUT #1, C$
70 PRINT C$
80 CLOSE 1
```

will yield

```
CUSTOMER INFORMATION? LINDA JONES
234,4 MEMPHIS LINDA JONES 234,4
MEMPHIS
```

LIST Command

Syntax: LIST [<*line number*>][—[<*line number*>]] [,<*device*>]

<*line number*> is in the range 0 to 65529.

<*device*> is a device designation string, such as SCRN: or LPT1:, or a filename.

Purpose: To list all or part of the program currently in memory.

Remarks: GW-BASIC always returns to command level after a LIST is executed.

If <*line number*> is omitted, the program is listed beginning at the lowest line number. (Listing is terminated either when the end of the program is reached or by typing Break.) If <*line number*> is included, only the specified line will be listed.

If only the first <*line number*> — is specified, that line and all higher-numbered lines are listed.

If only the second —<*line number*> is specified, all lines from the beginning of the program through that line are listed.

If both <*line number(s)*> are specified, the entire range is listed.

If the <*device*> is omitted, the listing is shown at the screen.

Examples: LIST Lists the program currently in memory.

LIST 500 Lists line 500.

LIST 150– Lists all lines from 150 to the end.

LIST –1000
List all line from the lowest number through 1000.

LIST 150 –1000
Lists lines 150 through 1000, inclusive.

LIST 150 –1000,"LPT1:"
Lists lines 150 through 1000 on the line printer.

LLIST Command

Syntax: LLIST [<*line number*>[–[<*line number*>]]]

Purpose: To list all or part of the program currently in memory on the line printer.

Remarks: LLIST assumes a 80-character-wide printer.

GW-BASIC always returns to command level after an LLIST is executed. The options for LLIST are the same as for the LIST Command.

Example: See the examples for the LIST Command. With the exception of the last one, which addresses a device, LLIST will work in a similar way.

LOAD Command

Syntax: LOAD <*filespec*>[,R]

Purpose: To load a file from an input device into memory.

Remarks: For loading a program, the <*filespec*> is an optional device specification followed by a filename or pathname that conforms to MS-DOS's rules for filenames. BASIC appends the default filename extension .BAS if the user specifies no extensions, when the file is saved to the disk.

The <*filespec*> must include the filename that was used when the file was saved, or created by an editor. (BASIC will append a default filename extension if one has been not supplied in the SAVE command.)

The R option automatically runs the program after it has been loaded.

LOAD closes all open files and deletes all variables and program lines currently residing in memory before it loads the designated program. However, if the R option is used with LOAD, the program is run after it is loaded, and all open data files are kept open. Thus, LOAD with the R option may be used to chain several programs (or segments of the same program). Information may be passed between the programs using their disk data files.

Example: LOAD "STRTRK",R

Loads and runs the program STRTRK.BAS

LOAD "B:MYPROG"

Loads the program MYPROG.BAS from the disk in drive B, but does not run the program.

LOC Function

Syntax: LOC (<*file number*>)

where <*file number*> is the number under which the file was opened.

Purpose: With random disk files, LOC returns the actual record number within the file.

With sequential files, LOC returns the current byte position in the file, divided by 128.

Remarks: When a file is opened for APPEND or OUTPUT, LOC returns the size of the file in (bytes/128).

For a communications file, LOC(X) is used to determine if there are any characters in the input queue waiting to be read. If there are more than 255 characters in the queue, LOC(X) returns 255. Since interpreter strings are limited to 255 characters, this practical limit alleviates the need for an interpreter user to test for string size before reading data into it.

If fewer than 255 characters remain in the queue, the value returned by LOC(X) depends on whether the device was opened in ASCII or binary mode. In either mode, LOC will return the number of characters that can be read from the device. However, in ASCII mode, the low level routines stop queueing characters as soon as end-of-file is received. The end-of-file itself is not queued and cannot be read. An attempt to read the end-of-file will result in an "Input past end" error.

Examples:

```
200 IF LOC (1)>50 THEN STOP
```

Execution stops when 50th record is processed.

```
PUT #2, LOC(2)
```

Used to re-write the same byte position.

LOCATE Statement

Syntax: LOCATE [<*row*>] [,[<*col*>] [,[<*cursor*>] [,[<*start*>] [,<*stop*>]]]]

<*row*> is a line number (vertical) on the screen. Row should be a numeric expression returning an unsigned integer in the range 1 through 25.

<*col*> is the column number on the screen. It should be a numeric expression returning an unsigned integer in the range 1 through 40 or 1 through 80, depending on the screen width.

<*cursor*> is a Boolean value indicating whether the cursor should be visible (1) or not (0).

<*start*> is the cursor starting line (vertical) on the screen. It should be a numeric expression returning an unsigned integer in the range 0 through 31.

<*stop*> is the cursor stop line (vertical) on the screen. It should be a numeric expression returning an unsigned integer in the range 0 through 31.

Purpose: Moves the cursor to the specified position. Optional parameters turn the blinking cursor on and off and define the vertical start and stop lines.

Remarks: Any value outside the specified ranges will result in an "Illegal function call" error. In this case, previous values are retained.

Any parameter may be omitted from the statement. If a parameter is omitted, the previous value is assumed.

Note that the <*start*> and <*stop*> lines are the raster lines that specify which pixels on the screen are lit. A wider range between the start and stop lines will produce a taller cursor, such as one that occupies an entire character block.

If the <*start*> line is given but the <*stop*> line is omitted, <*stop*> assumes the same value as <*start*>.

The last line on the screen is reserved for softkey display and is not accessible to the cursor unless the softkey display is off and LOCATE is used to get to it.

Note: <*cursor*>, <*start*>, <*stop*> cannot be specified when BASIC is in the graphic mode.

Example:

```
10 LOCATE 1,1
```

Moves cursor to upper-left corner of the screen.

```
20 LOCATE ,,1
```

Makes the cursor visible; position remains unchanged.

```
30 LOCATE ,,,7
```

Position and cursor visibility remain unchanged. Sets the cursor to display at the bottom of the character starting and ending on raster line 7.

```
40 LOCATE 5,1,1,0,7
```

Moves the cursor to line 5, column 1; turns cursor on. Cursor will cover entire character cell starting at scan line 0 and ending on scan line 7.

LOCK and UNLOCK Statements

Syntax:

LOCK [#]<*file number*>[,{<*record*>| [<*start*>] TO <*end*>}]

UNLOCK [#]<*file number*>[,{<*record*>|[<*start*>] TO <*end*>}]

Purpose:

These statements control access by other processes to part or all of an opened file.

Remarks:

These statements are for use in networked environments in which multiple users may be working on the same file simultaneously.

<*file number*> is the number that was used to open the file.

If only one <*record*> is specified, then only that particular record is locked or unlocked. If <*start*> and <*end*> are both specified, all records from the record specified by <*start*> to the record specified by <*end*> are locked or unlocked. If the starting record is omitted, then all records from the first record to the end of the range specified by <*end*> are locked or unlocked. If only <*file number*> is specified, the entire file is locked or unlocked.

If the file has been opened for random input or output, the records to be locked or unlocked are indicated by the range. If the file has been opened for sequential input or output, however, LOCK and UNLOCK affect the entire file without regard to the range specified by <*start*> and <*end*>.

Note:

Check that all locks are removed with an UNLOCK statement prior to closing a file or ending a program. Undefined results will occur if this step is not taken. The LOCK and UNLOCK statements must match exactly.

Example 1: The entry below locks the entire file opened as number 2:

```
LOCK #2
```

The entry below locks only record 32 in file number 2:

```
LOCK #2, 32
```

The entry below locks records 1 through 32 in file number 2:

```
LOCK #2, TO 32
```

The entry below locks records 9 through 32 in file number 2:

```
LOCK #2, 9 TO 32
```

Example 2: The UNLOCK below is legal:

```
LOCK #1, 1 TO 4
LOCK #1, 5 TO 8
UNLOCK #1, 1 TO 4
UNLOCK #1, 5 TO 8
```

The UNLOCK below is illegal because the range in an UNLOCK statement must exactly match the range in the corresponding LOCK statement:

```
LOCK #1, 1 TO 4
LOCK #1, 5 TO 8
UNLOCK #1, 1 TO 8
```

Followings are the possible error messages:

```
Bad record number
Permission denied
```

Example 3: The program fragment below will open a file. It then permits the operator to lock and update the information in an individual record. When the operator has completed this procedure, the program unlocks the locked record. (Unlocking the locked record allows other users to work with the file.)

```
100 OPEN "owes" AS #1 LEN=19
110 FIELD #1,15 AS NAM$,4 AS OWE$
120 UPD$="y"
130 WHILE (UPD$="y" OR UPD$="Y")
140     CLS:LOCATE 10,10
150     INPUT "Number? #",NUM
160     LOCK #1,NUM
170       GET #1, NUM
180       DOL=CVS (OWE$)
190       LOCATE 12,10
200       PRINT "NAME: ";NAM$
210       LOCATE 13,10
220       PRINT "Currently owes: $";DOL
230       LOCATE 15,10
240       INPUT "Change (+ or -) ",CHG
250       DOL=DOL+CHG
260       LSET OWE$=MKS$(DOL)
270       PUT #1,NUM
280     UNLOCK #1,NUM
290     LOCATE 17,10
300     INPUT "Update another?",A$
310     UPD$=LEFT$ (A$,1)
320 WEND
```

LOF Function

Syntax: LOF (<*file number*>)

Purpose: To return the length of the specified file in bytes.

Remark: When a file is opened for APPEND or OUTPUT, LOF returns the size of the file, in bytes.

Example:

```
110 IF REC*RECSIZ>LOF(1)
THEN PRINT "INVALID ENTRY"
```

In this example, the variables REC and RECSIZ contain the record number and record length, respectively. The calculation determines whether the specified record is beyond the end-of-file.

LOG Function

Syntax: LOG (*x*)

Purpose: To return the natural logarithm of *x*. *x* must be greater than zero.

Example: PRINT LOG(45/7)

will yield

```
 1.860752
```

LPOS Function

Syntax: LPOS (*x*)

where *x* is the index of the printer being tested; that is LPT1: would be tested with LPOS(0) or LPOS(1), LPT2: with LPOS(2), LPT3: with LPOS(3).

Purpose: To return the current position of the printer's print head within the printer buffer.

Remarks: LPOS does not necessarily give the physical position of the print head.

Example:

```
100 IF LPOS(X)>60 THEN LPRINT CHR$(13)
```

In the example above, if the line length exceeds more than 60 characters long, BASIC sends a carriage return cord to the printer.

LPRINT And LPRINT USING Statements

Syntax: LPRINT [<*list of expressions*>] [;]

LPRINT USING <*string exp*>;<*list of expressions*>[;]

Purpose: To print data on the printer.

Remarks: Same as PRINT and PRINT USING, except output goes to the line printer, and the file number option is not permitted.

LPRINT assumes a 80-character-wide printer.

Example: See PRINT and PRINT USING Statements.

LSET And RSET Statements

Syntax: LSET <*string variable*> = <*string expression*>
RSET <*string variable*> = <*string expression*>

Purpose: To move data from memory to a random file buffer (in preparation for a PUT statement) or to left- or right-justify the value of a string into a string variable.

Remarks: If <*string expression*> requires fewer bytes than were fielded to <*string variable*>, LSET left-justifies the string in the field, and RSET right-justifies the string. (Spaces are used to pad the extra positions.) If the string is too long for the field, characters are dropped from the right. Numeric values must be converted to strings before they are LSET or RSET. See MKI$, MKS$, MKD$ functions.

Examples:
```
150 LSET A$ = MKS$ (AMT)
160 LSET D$ = MKI$(COUNT%)
```

Note: LSET or RSET may also be used with a nonfielded string variable to left-justify or right-justify a string in a given field. For example, the program lines

```
110 A$ = SPACE$(20)
120 RSET A$ = N$
```

right-justify the string N$ in a 20-character field. This can be very handy for formatting printed output.

MERGE Command

Syntax: MERGE <*filespec*>

Purpose: To merge a specified file into the program currently in memory.

Remarks: For merging a program not in memory, the <*filespec*> is an optional device specification followed by a filename or pathname that conforms to MS-DOS's rules for filenames. BASIC appends the default filename extension ".BAS" if the user specifies no extensions, and the file has been saved to the disk.

If any line in the disk file has the same line number as lines in the program in memory, the lines from the file on disk will replace the corresponding lines in memory. (MERGEing may be thought of as "inserting" the program lines on disk into the program in memory.)

Microsoft GW-BASIC always returns to command level after executing a MERGE command.

Note: A file to be merged must be saved in ASCII format or an error occurs. To active this, add A option to the SAVE command.

Example: MERGE "NUMBRS"

Inserts, by sequential line number, all lines in the program NUMBRS.BAS into the program currently in memory.

MID$ Statement

Syntax: MID$ (<*string 1*>,*n*[,*m*])= <*string 2*>

where *n* and *m* are integer expressions and <*string 1*> and <*string 2*> are string expressions.

Purpose: To replace a portion of one string with another string.

Remarks: The characters in <*string 1*>, beginning at position n, are replaced by the characters in <*string 2*>. The optional "*m*" refers to the number of characters from <*string 2*> that will be used in the replacement. If "*m*" is omitted, all of <*string 2*> is used. However, regardless of whether "*m*" is omitted or included the replacement of characters never goes beyond the original length of <*string 1*>.

Example:

```
10 A$="KANSAS CITY, MO"
20 MID$(A$,13)="KS"
30 PRINT A$
```

will yield

```
KANSAS CITY, KS
```

MID$ is also a function that returns a substring of a given string. See MID$ function.

MID$ Function

Syntax: MID$ (<*string*>,*n*[,*m*])

Purpose: To return a string of length *m* characters from <*string*> beginning with the *n*th character.

Remarks: *n* and *m* must be in the range 1 to 255. If *m* is omitted or if there are fewer than *m* characters to the right of the *n*th character, all rightmost characters beginning with the *n*th character are returned. If *n* is greater than the number of characters in <*string*> that is, (LEN(<*string*>)), MID$ returns a null string.

Example:

```
10 A$ = "GOOD "
20 B$ = "MORNING EVENING AFTERNOON"
30 PRINT A$;MID$(B$,9,7)
```

will yield

```
GOOD EVENING
```

Also see the LEFT$ and RIGHT$ functions.

MKDIR Statement

Syntax: MKDIR *<pathname>*

Purpose: To create a new directory

Remarks: *<pathname>* is a string expression specifying the name of the directory which is to be created. MKDIR works exactly like the MS-DOS command MKDIR. The *<pathname>* must be a string of less than 64 characters. (See "File Handling," for a discussion of tree-structured directories).

Example 1: Assume the current directory is the root.

```
MKDIR "SALES"
```

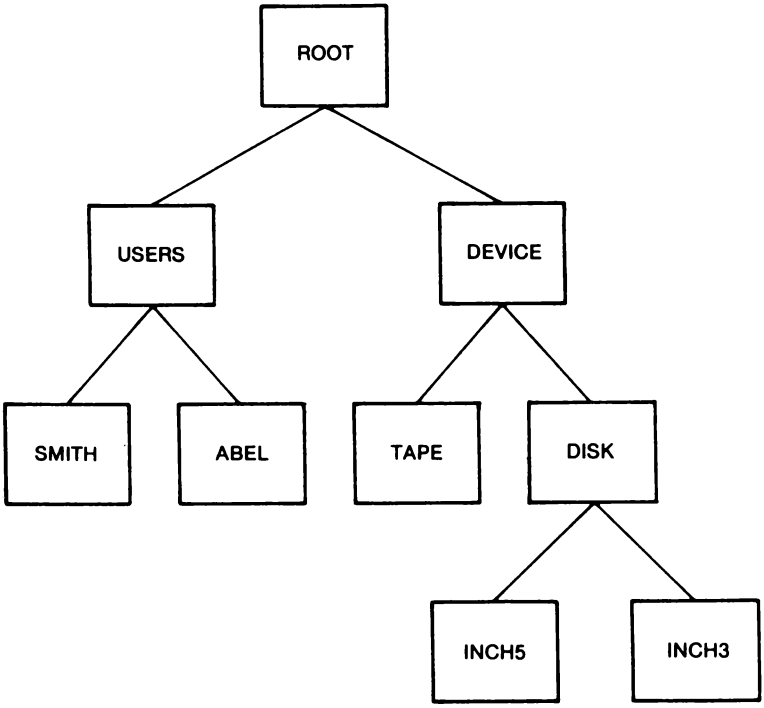
Creates a sub-directory named SALES in the current directory of the current drive.

```
MKDIR "B:USERS"
```

Creates a sub-directory named USERS in the current directory of drive B.

Also see the CHDIR and RMDIR statements.

Example 2:



When you intend to make directories which have above structure, make directories by referring to the following chart.

from	create	examples on the screen
ROOT	DEVICE	MKDIR "DEVICE"
ROOT	DISK	MKDIR "DEVICE \ DISK"
DEVICE	DISK	MKDIR "DISK"
DEVICE	INCH3	MKDIR "DISK \ INCH3"

All directories should exist before executing.

MKI$, MKS$, MKD$ Functions

Syntax: MKI$ (<*integer expression*>)
MKS$ (<*single precision expression*>)
MKD$ (<*double precision expression*>)

Purpose: To convert numeric values to string values.

Remarks: Any numeric value that is placed in a random file buffer with an LSET or RSET statement must be converted to a string. MKI$ converts an integer to a 2-byte string. MKS$ converts a single precision number to a 4-byte string. MKD$ converts a double precision number to an 8-byte string.

Example:

```
90 AMT = (K + T)
100 FIELD #1,8 AS D$,20 AS N$
110 LSET D$ = MKS$(AMT)
120 LSET N$ = A$
130 PUT #1
.
.
.
```

See also CVI, CVS, CVD Functions.

NAME Statement

Syntax: NAME *<old filename>* AS *<new filename>*

Purpose: To change the name of a disk file.

Remarks: *<old filename>* must exist and *<new filename>* must not exist; otherwise, an error will result. Also, both files must be on the same drive.

A file may not be renamed with a new drive designation. If this is attempted, a "Rename across disks" error will be generated. After a NAME command, the file exists on the same disk with the new name.

NAME may not be used to rename directories.

<old filename> must be closed before the renaming command is executed. Also, there must be one free file handle.

Example:

```
NAME "ACCOUNT.BAS" AS "BILL.BAS"
```

In this example, the file that was formerly named ACCOUNT.BAS will now be named BILL.BAS.

NAME may be used to move a file from one directory to another. For example:

```
NAME "\X\CLIENTS" AS
"\XYZ\P\CLIENTS"
```

NEW Command

Syntax: NEW

Purpose: To delete the program currently in memory and clear all variables.

Remarks: NEW is entered in direct mode to clear memory before entering a new program. Microsoft GW-BASIC always returns to command level after a NEW is executed.

NEW closes all files and turns tracing off.

Example: NEW

OCT$ Function

Syntax: OCT$ (*x*)

Purpose: To return a string that represents the octal value of the decimal argument. *x* is rounded to an integer before OCT$(*x*) is evaluated.

Example: PRINT OCT$(24)

will yield

30

See the HEX$ function for details on hexadecimal conversion.

ON COM Statement

Syntax: ON COM (*n*) GOSUB <*line number*>

where <*line number*> is the number of the first line of a subroutine that is to be performed when activity occurs on the specified communications port.

(*n*) is the number of the communications port.

Purpose: To specify the first line number of a subroutine to be performed when activity occurs on a communications port.

Remarks: A <*line number*> of zero disables the communications event trap.

The ON COM statement will only be executed if a COM (*n*) ON statement has been executed (see COM Statement) to enable event trapping. If event trapping is enabled, and if the <*line number*> in the ON COM statement is not zero, GW-BASIC checks between statements to see if communications activity has occurred on the specified port. If communications activity has occurred, a GOSUB will be performed to the specified line.

If a COM OFF statement has been executed for the communications port (see COM Statement), the GOSUB is not performed and is not remembered.

If a COM STOP statement has been executed for the communications port (see COM Statement), the GOSUB is not performed, but will be performed as soon as a COM ON statement is executed.

When an event trap occurs (i.e., the GOSUB is performed), an automatic COM STOP is executed so that recursive traps cannot take place. The RETURN from the trapping subroutine will automatically perform a COM ON statement unless an explicit COM OFF has been performed inside the subroutine.

The RETURN <*line number*> form of the RETURN statement may be used to a specific line number from the trapping subroutine. Use this type of return with care, however, because any other GOSUBs, WHILEs, that were active at the time of the trap will remain active, and errors such as "FOR without NEXT" may result.

Event trapping does not take place when GW-BASIC is not executing a program, and event trapping is automatically disabled when an error trap occurs.

Example:

```
10 OPEN "COM 1:" AS #1
20 ON COM(1) GOSUB 100
30 COM (1) ON
50 'Main routine
.
.
.
100 'Communication receiving subroutine
.
.
.
150 RETURN
```

This program normally executes the main routine, and immediately branches to sub-routine (line number 100) in case communication data is received.

ON ERROR GOTO Statement

Syntax: ON ERROR GOTO <*line number*>

Purpose: To enable error handling and specify the first line of the error handling routine.

Remarks: Once error handling has been enabled, all errors detected, including direct mode error (e.g., syntax errors), will cause a jump to the specified error handling routine. If <*line number*> does not exist, an "Undefined line" error results.

To disable error handling, execute an ON ERROR GOTO 0. Subsequent errors will print an error message and halt execution. An ON ERROR GOTO 0 statement that appears in an error handling routine causes Microsoft GW-BASIC to stop and print the error message for the error that caused the trap. It is recommended that all error handling routines execute an ON ERROR GOTO 0 if an error is encountered for which there is no recovery action.

Note: If an error occurs during execution of an error handling routine, that error message is printed and execution terminates. Error trapping does not occur within the error handling routine.

Example:

```
10 ON ERROR GOTO 1000
.
.
.
1000 PRINT "Error occurred!"
.
.
.
1050 RESUME
```

ON GOSUB And ON...GOTO Statements

Syntax: ON <*expression*> GOTO <*list of line numbers*>

ON <*expression*> GOSUB <*list of line numbers*>

Purpose: To branch to one of several specified line numbers, depending on the value returned when an expression is evaluated.

Remarks: The value of <*expression*> determines which line number in the list will be used for branching. For example, if the value is three, the third line number in the list will be the destination of the branch. (If the value is a noninteger, the number is rounded.)

In the ON...GOSUB statement, each line number in the list must be the first line number of a subroutine.

It the value of <*expression*> is either zero or greater than the number of items in the list, control drops to the next BASIC statement.

If the value of <*expression*> is negative or greater than 255, an "Illegal function call" error occurs.

Example:

```
100 ON M-2 GOTO 150,300,320,390
110 'Next line
```

In this example, if the value of M-2 is 1, execution branches to the line number 150. If M-2 is 2, then branches to the line 300 and so on. If the value of M-2 is larger than 5 or equal to 0, next line (line number 110) will be executed. An error will occur when M-2 is smaller than 0.

ON KEY Statement

Syntax: ON KEY (*n*) GOSUB <*line number*>

(*n*) is the number of a function key, direction key, or user-defined key.

<*line number*> is the number of the first line of a subroutine that is to be performed when the specified function or cursor direction key is pressed.

Purpose: To specify the first line number of a subroutine to be performed when a specified key is pressed.

Remarks: (*n*) represents that:

1 through 10:	function keys F1 through F10
11:	cursor control (Up)
12:	cursor control (Left)
13:	cursor control (Right)
14:	cursor control (Down)
15 through 20:	keys defined with KEY (n) statement.

A <*line number*> of zero disables the event trap.

The ON KEY Statement will only be executed if a KEY (*n*) ON statement has been executed (see KEY (*n*) Statement) to enable event trapping. If key trapping is enabled, and if the <*line number*> in the ON KEY statement is not zero, GW-BASIC checks between statements to see if the specified function, user-defined or cursor direction key has been pressed. If so, the program will branch to a subroutine specified by the GOSUB statement.

If a KEY (*n*) OFF statement has been executed for the specified key, (see KEY (*n*) Statement), the GOSUB is not performed and is not remembered.

If a KEY (*n*) STOP statement has been executed for the specified key, (see KEY (*n*) Statement), the GOSUB is not performed, but will be performed as soon as a KEY (*n*) ON statement is executed.

When an event trap occurs (i.e., the GOSUB is performed), an automatic KEY (*n*) STOP is executed so that recursive traps cannot take place. The RETURN from the trapping subroutine will automatically perform a KEY (*n*) ON statement unless an explicit KEY (*n*) OFF has been performed inside the subroutine.

The RETURN <*line number*> form of the RETURN statement may be used to return to a specific line number from the trapping subroutine. Use this type of return with care, however, because any other GOSUBs, WHILEs, or FORs that were active at the time of the trap will remain active, and errors such as "FOR without NEXT" may result.

Event trapping does not take place when GW-BASIC is not executing a program, and event trapping is automatically disabled when an error trap occurs.

The following rules apply to keys trapped by BASIC:

1. The line printer echo toggle key is processed first. Defining this key as a user defined key trap will not prevent characters from being echoed to the line printer if depressed.

2. Function keys and the cursor direction keys are examined next. Defining a function key or cursor direction key as a user defined key trap will have no effect as they are considered predefined.

3. Finally, the user defined keys are examined.

4. Any key that is trapped is not passed on. That is, the key is not read by BASIC.

WARNING:

This may apply to any key, including Break or system reset performed by pressing Ctrl-Alt-Del keys together. This is a powerful feature when you consider that it is now possible to prevent BASIC Application users from accidentally breaking out of a program, or worse yet, rebooting the machine.

Note: When a key is trapped, that occurrence of the key is destroyed. Therefore, you cannot subsequently use the INPUT or INKEY$ statements to find out which key caused the trap. So if you wish to assign different functions to particular keys, you must set up a different subroutine for each key, rather then assigning the various functions within a single subroutine.

The ON KEY (*n*) statement allows 6 additional user defined KEY traps. This allows any key, control-key, shift-key, or super-shift-key to be trapped by the user as follows:

ON KEY (*i*) GOSUB <*line number*>

Where: <*i*> is an integer expressing a legal user-defined key number.

Example:

```
10 KEY 4, "SCREEN 0,0" 'assigns softkey 4
20 KEY(4) ON 'enables event trapping
.
.
70 ON KEY(4) GOSUB 200
.
.
.
key F4 pressed
.
.
.
200 'Subroutine for screen
```

In the above, the programmer has overridden the normal function associated with function key F4, and replaced it with "SCREEN 0,0", which will be printed whenever that key is pressed. The value may be resigned and it will resume its standard function when the machine is rebooted.

```
100 KEY 16, CHR$(&H04) + CHR$(83)
105 REM **Key 16 now is Control-S**
110 KEY(16) ON
    .
    .
    .
1000 PRINT "If you want to stop processing for a
break"
1010 PRINT "press the Control key and the 'S' at
the"
1020 PRINT "same time."
```

```
1030 ON KEY(16) GOSUB 3000
      .
Operator presses Control-S
      .
3000 REM ** Suspend processing loop.
3010 CLOSE #1
3020 RESET
3030 CLS
3035 PRINT "Enter CONT to continue."
3040 STOP
3050 OPEN "A", #1, "ACCOUNTS.DAT"
3060 RETURN
```

In the above, the programmer has enabled the Control-S key to enter a subroutine which closes the files and stops program execution until the operator is ready to continue.

ON PEN Statement

Syntax: ON PEN GOSUB <*line number*>

where <*line number*> is the number of the first line of a subroutine that is to be performed when the lightpen is activated.

Purpose: To specify the first line number of a subroutine to be performed when the lightpen is activated.

Remarks: A <*line number*> of zero disables the pen event trap.

The ON PEN statement will only be executed if a PEN ON statement has been executed (see PEN ON Statement and PEN Function) to enable event trapping. If event trapping is enabled, and if the <*line number*> in the ON PEN statement is not zero, GW-BASIC checks between statements to see if the lightpen has been activated. If the lightpen has been activated, a GOSUB will be performed to the specified line.

If a PEN OFF statement has been executed (see PEN OFF Statement), the GOSUB is not performed and is not remembered.

If a PEN STOP statement has been executed (see PEN STOP Statement), the GOSUB is not performed, but will be performed as soon as a PEN ON statement is executed.

When an event trap occurs (i.e., the GOSUB is performed), an automatic PEN STOP is executed so that recursive traps cannot take place. The RETURN from the trapping subroutine will automatically perform a PEN ON statement unless an explicit PEN OFF was performed inside the subroutine.

The RETURN <*line number*> form of the RETURN statement may be used to return to a specific line number from the trapping subroutine. Use this type of return with care, however, because any other GOSUBs, WHILEs, or FORs that were active at the time of the trap will remain active, and errors such as "FOR without NEXT" may result.

Event trapping does not take place when GW-BASIC is not executing a program, and event trapping is automatically disabled when an error trap occurs.

Example:

```
.
.
.
50 ON PEN GOSUB 200
60 PEN ON
.
.
.
200 'sub-routine using pen
. .
.
.
250 RETURN
```

ON PLAY Statement

Syntax: ON PLAY (*n*) GOSUB <*line number*>

(*n*) is an Integer expression in the range 1 through 32. Values outside this range will result in an "Illegal function call" error.

<*line number*> is the statement line number of the Play event trap subroutine.

Purpose: To branch to a specified subroutine when the music queue contains fewer than (*n*) notes. This permits continuous music during program execution.

Remarks: ON PLAY causes an event trap when the Background Music queue goes from (n) notes to (n – 1) notes.

PLAY ON	Enables Play event trapping
PLAY OFF	Disables Play event trapping
PLAY STOP	Suspends Play event trapping

If a PLAY OFF statement has been executed the GOSUB is not performed and is not remembered.

If a PLAY STOP statement has been executed the GOSUB is not performed, but will be performed as soon as a PLAY ON statement is executed.

When an event trap occurs (i.e., the GOSUB is performed), an automatic PLAY STOP is executed so that recursive traps cannot take place. The RETURN from the trapping subroutine will automatically perform a PLAY ON statement unless an explicit PLAY OFF was performed inside the subroutine.

The RETURN <*line number*> form of the RETURN statement may be used to return to a specific line number from the trapping subroutine. Use this type of return with care, however, because any other GOSUBs, WHILEs, or FORs that were active at the time of the trap will remain active, and errors such as "FOR without NEXT" may result.

Rules:

1. A play event trap is issued only when playing background music (e.g. PLAY "MB..). Play event traps are not issued when running in Music Foreground (e.g., default case, or PLAY "MF..).

2. A play event trap is not issued if the background music queue has already gone from having (n) to (n – 1) notes when a PLAY ON is executed.

3. If (n) is a large number, event traps will occur frequently enough to diminish program execution speed.

Also see PLAY ON, PLAY OFF, PLAY STOP Statements.

Example: In this example control branches to a subroutine when the background music buffer decreases to 7 notes.

```
100 PLAY ON
      .
      .
540 PLAY "MB L1 XZITHER$"
550 ON PLAY(8) GOSUB 6000
      .
      .
      .
6000 REM **BACKGROUND MUSIC**
6010 LET COUNT% = COUNT% + 1
      .
      .
6999 RETURN
```

ON STRIG Statement

Syntax: ON STRIG (*n*) GOSUB <*line number*>

where (*n*) is the number of the joystick trigger, may be 0, 2, 4 or 6.

where <*line number*> is the number of the first line of a subroutine that is to be performed when the joystick trigger is pressed.

Purpose: To specify the first line number of a subroutine to be performed when the joystick trigger is pressed.

Remarks: (*n*) represents:

0: button A1
2: button B1
4: button A2
6: button B2

A <*line number*> of zero disables the event trap.

The ON STRIG statement will only be executed if a STRIG ON statement has been executed (see STRIG Function and STRIG Statements) to enable event trapping. If event trapping is enabled, and if the <*line number*> in the ON STRIG statement is not zero, GW-BASIC checks between statements to see if the joystick trigger has been pressed. If it has, a GOSUB will be performed to the specified line.

If a STRIG OFF statement has been executed (see STRIG Statement), the GOSUB is not performed and is not remembered.

If a STRIG STOP statement has been executed (see STRIG Statement), the GOSUB is not performed, but will be performed as soon as a STRIG ON statement is executed.

When an event trap occurs (i.e., the GOSUB is performed), an automatic STRIG STOP is executed so that recursive traps cannot take place. The RETURN from the trapping subroutine will automatically perform a STRIG ON statement unless an explicit STRIG OFF was performed inside the subroutine.

The RETURN <*line number*> form of the RETURN statement may be used to return to a specific line number from the trapping subroutine. Use this type of return with care, however, because any other GOSUBs, WHILEs, or FORs that were active at the time of the trap will remain active, and errors such as "FOR without NEXT" may result.

Event trapping does not take place when GW-BASIC is not executing a program, and event trapping is automatically disabled when an error trap occurs.

Example:

```
20 ON STRIG(2) GOSUB 1000
30 STRIG(2) ON
.
.
.
1000 'Button B1
.
.
.
1100 RETURN
```

ON TIMER Statement

Syntax: ON TIMER (*n*) GOSUB <*line number*>

Purpose: To provide an event trap during real time.

Remarks: ON TIMER causes an event trap every (n) seconds. (*n*) must be a numeric expression in the range of 1 to 86400 (1 second to 24 hours). Values outside this range generate "Illegal function call" error.

The ON TIMER statement will only be executed if a TIMER ON statement has been executed to enable event trapping. If event trapping is enabled, and if the <*line number*> in the ON TIMER statement is not zero, GW-BASIC checks between statements to see if the time has been reached. If it has, a GOSUB will be performed to the specified line.

If a TIMER OFF statement has been executed the GOSUB is not performed and is not remembered.

If a TIMER STOP statement has been executed the GOSUB is not performed, but will be performed as soon as a TIMER ON statement is executed.

When an event trap occurs (i.e., the GOSUB is performed), an automatic TIMER STOP is executed so that recursive traps cannot take place. The RETURN from the trapping subroutine will automatically perform a TIMER ON statement unless an explicit TIMER OFF was performed inside the subroutine.

The RETURN <*line number*> form of the RETURN statement may be used to return to a specific line number from the trapping subroutine. Use this type of return with care, however, because any other GOSUBs, WHILEs, or FORs that were active at the time of the trap will remain active, and errors such as "FOR without NEXT" may result.

Example: Display the time of day on line 1 every minute.

```
10 ON TIMER(60) GOSUB 10000
20 TIMER ON
      .
      .
      .
10000 LET OLDROW = CSRLIN 'Save current Row
10010 LET OLDCOL = POS(0) 'Save current Column
10020 LOCATE 1,1:PRINT TIME$;
10030 LOCATE OLDROW,OLDCOL 'Restore Row
& Col
10040 RETURN
```

Also see TIMER ON, TIMER OFF and TIMER STOP Statements.

OPEN Statement

Syntax 1: OPEN <*mode 1*>,[#]<*file number*>,<*filespec*> [,<*record length*>]

Syntax 2: OPEN <*filespec*> [FOR <*mode 2*>][<*access*>] AS [#]<*file number*> [LEN = <*record length*>]

Purpose: Allows input/output operations to a file or device.

Remarks: <*filespec*> is an optional device specification that is followed by a filename or pathname which conforms to the MS-DOS Version 3.0 rules for filenames.

<*mode 1*> is a string expression. The first character must be one of the following:

O	Specifies sequential output mode.
I	Specifies sequential input mode.
R	Specifies random input/output mode.
A	Specifies sequential output mode and sets the file pointer at the end of file and the record number as the last record of the file. A PRINT # or WRITE # statement will then extend (append) the file.

In the second syntax given, <*mode 2*> is one of the following words:

OUTPUT	Specifies sequential output mode.
INPUT	Specifies sequential input mode.
APPEND	Specifies sequential output mode and sets the file pointer at the end of file and the record number as the last record of the file. A PRINT # or WRITE # statement will then extend (append) the file.

If <*mode 2*> is omitted, the default random access mode is assumed. However, random cannot be expressed explicitly as the file mode.

A major difference between this 3.1 Version of the interpreter and the 2.0 Version is the inclusion of the <*access*> clause to provide support for networking. Any one of the following may be used as the <*access*> argument:

default	If <*access*> in not specified, the file may be opened for reading and writing as many times as desired by this process, but other processes are not granted access to the file as long as it is opened.
SHARED	This file may be read from or written to by any process on any machine.
LOCK READ	No other process is granted read access to this file. This access is granted only on the condition that no other process has a previous access of this type to the file.
LOCK READ WRITE	No other process is granted either read or write access to this file. Again in this case, this access is granted only on the condition that LOCK READ WRITE has not already been granted to another process.

<*file number*> is an integer expression having a value between 1 and 255. This number is then associated with the file as long as it is open and is used to refer other disk I/O statements to the file.

<*record length*> is an integer expression that is optional. When is is included, this expression sets the record length for random files. BASIC ingores this option if it is used in a statement to open a sequential file. Unless the command line options /I and /R have been employed, the default length for records is 128 bytes.

Remarks: Before any operation can be performed on a file, the file must be opened. OPEN allocates a buffer for input/output operations to the file or device and determines the access mode that will be utilized with the buffer.

The OPEN statement permits specification of <*pathname*> in lieu of <*filespec*>. If a <*pathname*> is utilized and a drive is included in the <*pathname*>, the drive must be included at the beginning of the <*pathname*>. In other words, "B:\SALES\JOHN" is legal, while "\SALES\B:JOHN" is not legal.

If the file being opened has been specified as a sequential file, the LEN= option is ignored.

Because it is possible to use different paths to refer to the same file in a subdirectory, BASIC is practically incapable of determining that it is the same file simply by looking at the path. Due to this limitation, BASIC will not allow the file for OUTPUT or APPEND to be opened if it is on the same disk even if the path is different. As an example, if MARY is the current directory, then:

```
OPEN "REPORT"...
OPEN "ESMARYREPORT"...
OPEN "..MARYREPORT"...
OPEN "...MARYREPORT"...
```

all refer to the same file.

MS-DOS Devices

BASIC devices include:
KYBD: LPT*n*: SCRN: CON: COM*n*: CAS*n*:

The BASIC file I/O system has been designed to permit maximum utilization of user-installed devices. (Refer to the MS-DOS manual for complete information on character devices.)

Opened character devices are opened and utilized in the same manner as disk files. However, BASIC does not buffer characters for devices as it does for disk files. The record length is set to one.

BASIC only sends a CR (carriage return X'0D') at the end of a line. If the device being used requires a LF (line feed X'0A'), the device drive must provide it. With regard to the writing of device drivers, it is important to remember that other BASIC users will want to read and write control information. Writing and reading of device control information is accomplished by using the BASIC IOCTL statement and the IOCTL$(f) function.

Note: Keep in mind that a file can be opened for sequential input or random access on multiple file numbers at the same time. A file may be opened for output, however, on only one file number at one time.

Examples:

```
10 OPEN "I",2,"INVEN"
```

The example above opens the file named INVEN and allows input as file 2.

```
10 OPEN "MAILING.DAT" FOR APEND
AS 1
```

The above example assigns MAILING.DAT to file 1 and allows the input of additional data without destroying or overwriting data that are currently resident in the file.

If you write and install a device named FOO, then the OPEN statement could be entered as:

```
10 OPEN "\DEV\FOO" FOR OUTPUT AS
1
```

The following line could be used as the OPEN statement for the printer:

```
100 OPEN "LPT:" FOR OUTPUT AS 1
```

The preceding example employs the GW-BASIC device driver. The same result could be achieved by using it as part of a pathname utilizing the MS-DOS device driver, as in

```
100 OPEN "\DEV\LPT1" FOR OUTPUT
AS 1
```

OPEN COM Statement

Syntax: OPEN "COM*n*:[<*speed*>]
[,<*parity*>] [,<*data*>]
[,<*stop*>] [,RS] [,CS[*n*]] [,DS[*n*]] [,CD[*n*]] [,LF]
[,PE]" AS [#]<*filenumber*> [LEN = <*number*>]

COM*n*: is the name of the device to be opened.

n: is the name of RS-232C port. Specify either 1 or 2.

<*speed*> is the baud rate, in bits per second, of the device to be opened. Available values are 75, 110, 150, 300, 600 , 1200, 1800, 2400, 4800 and 9600. The default value is 300.

<*parity*> designates the parity of the device to be opened. Valid entries are: N (None), E (Even), O (Odd), S (Space), or M (Mark). The default is E.

<*data*> designates the number of data bits per type. Valid entries are: 5, 6, 7 or 8. The default is 7.

<*stop*> designates the stop bit. Valid entries are 1 or 2. The default value is 2 for 75 and 110 baud per second. For another communication speed, it defaults 1.

RS supresses RTS (Request To Send).
CS [*n*] controls CTS (Clear To Send).
DS [*n*] controls DSR (Data Set Ready).
CD [*n*] controls CD (Carrier Detect).

LF specifies that a line feed is to be sent after a carriage return. See "Remarks" for further discussion of LF.

PE enables parity checking.

Filenumber is the number of the file to be opened.

Purpose: To open and initialize a communications channel for input/output.

Remarks: The OPEN COM statement must be executed before a device can be used for RS-232C communication.

Any syntax errors in the OPEN COM statement will result in a "Bad File name" error.

The <*speed*>, <*parity*>, <*data*>, and <*stop*> options must be listed in the order shown in the above syntax. The remaining options may be listed in any order, but they must be listed after the <*speed*>, <*parity*>, <*data*>, and <*stop*> options.

A "Device timeout" error will occur if Data Set Ready (DSR) or Clear To Send (CTS) signal is not detected for one second.
n argument in CS, DS and CD parameters specifies the number of milliseconds to wait for the signal before returning a "Device timeout" error. n can be taken in the range 0 through 65535.

LF allows communication files to be printed on a serial line printer. When LF is specified, a line feed character (0AH) is automatically sent after each carriage return character (0CH). This includes the carriage return sent as a result of the width setting. Note that INPUT # and LINE INPUT #, when used to read from a COM file that was opened with the LF option, stop when they see a carriage return, ignoring the line feed.

PE allows parity check. If omitted BASIC checks no parity. When specified, and there is a parity error, "Device I/O error" still cause. In this case PE turns data bits to 7 or less bits.

Examples: 10 OPEN "COM1:" AS 1

File number 1 is opened for input and output with all options are default setting. Such as communication rate is 300 baud per second, 7 data bits, 1 stop bit and even parity.

10 OPEN "COM1: 9600,N,8,1,CS0,DS0,CD0" AS 1

it opens the file number 1 for communication speed is 9600 baud per second with 8 data bits and 1 stop bit. Parity check is not performed and it ignores the CTS, DSR and CD lines, so these status may be either logic 0 or 1.

OPTION BASE Statement

Syntax: OPTION BASE *n*

where *n* is 1 or 0

Purpose: To declare the minimum value for array subscripts.

Remarks: The default base is 0. If the statement

```
OPTION BASE 1
```

is executed, the lowest value an array subscript may have is 1.

The OPTION BASE statement must be coded before you define or use any arrays.

Chained programs may have an OPTION BASE statement if no arrays are passed between them or the specified base is identical in the chained programs. The chained program will inherit the OPTION BASE value of the chaining program.

Example:

```
10 OPTION BASE 1
```

OUT Statement

Syntax: OUT *i, j*

where *i* is the port number. It must be an integer expression in the range 0 to 65535.

j is the data to be transmitted. It must be an integer expression in the range 0 to 255.

Purpose: To send a byte to a machine output port.

Example:

```
100 OUT 12345,255
```

In 8086 assembly language, this is equivalent to:

```
MOV DX,12345
MOV AL,255
OUT DX,AL
```

Outputs the value 255 to the port 12345.

PAINT Statement

Syntax: PAINT (<*x-start*>, <*y-start*>) [,<*paint attribute*>
[,<*border color*>] [,<*background attribute*>]]

Purpose: To fill a graphics area with the color or pattern specified.

(<*x-start*>, <*y-start*>) are the coordinates where painting is to begin. Painting should always start on a non-border point. If painting starts within a border, the bordered figure is painted. If painting starts outside a bordered figure, the background is painted.

If the <*paint attribute*> is a string expression PAINT will execute "Tiling", a process similar to "Line-styling". Like LINE, PAINT looks at a "tiling" mask each time a point is put down on the screen.

If <*paint attribute*> is a numeric expression, then the number must be a valid color and is used to paint the area as before. (see COLOR Statement). If the <*paint attribute*> is not specified, the foregound color will be used.

<*border color*> identifies the border color of the figure to be filled. When the border color is encountered, painting of the current line will stop. If the <*border color*> is not specified, the <*paint attribute*> will be used.

<*background attribute*> is a string formula returning character data. When it is omitted, the default is CHR$(0).

When specified, <*background attribute*> gives the "background tile slice" to skip when checking for termination of the boundary. Painting is terminated when adjacent points display the paint color; specifying a background tile slice allows the user to paint over an already painted area without terminating the process because two consecutive lines with the same paint attributes are encountered.

Remarks: Painting is complete when a line is painted without changing the color of any pixel; i.e., the entire line is equal to the paint color.

The PAINT command can be used to fill any figure, but painting complex figures may result in an "Out of Memory" error. If this happens, the CLEAR statement may be given to increase the amount of stack space available.

The PAINT command permits coordinates outside the screen or viewport.

Tiling

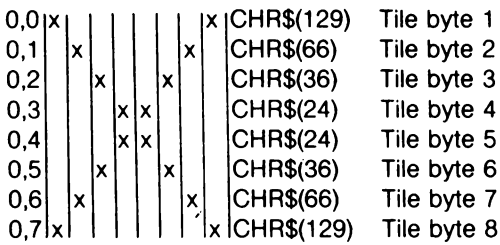
Tiling is the design of PAINT pattern that is 8 bits wide and up to 64 bytes long. Each byte in the Tile String masks 8 bits along the x axis when putting down points. Construction of this Tile mask works as follows:

Use the syntax PAINT (*x,y*), CHR$ (*n*)...CHR$ (*n*) where (*n*) is a number between 0 and 255 which will be represented in binary across the x-axis of the "tile". Each CHR$ (*n*) up to 64 will generate an image not of the assigned character, but of the bit arrangement of the code for that character. For example, the decimal number 85 is binary "01010101"; the graphic image line on a black and white screen generated by CHR$ (85) is an eight pixel line, with even numbered points turned white, and odd ones black. That is, each bit containing a "1" will be set the associated pixel on and each bit filled with a "0" will set the associated bit off in a black and white system. The ASCII character CHR$ (85), which is "U", is not displayed in this case.

If the current screen mode supports only two colors, then the screen can be painted with 'X's with the following statement.

```
PAINT (320,100),CHR$(129) + CHR$(66)
+ CHR$(36) + CHR$(24) + CHR$(24) + CHR$(36)
+ CHR$(66) + CHR$(129)
```

This appears on the screen as:


x increases →
0,0 CHR$(129) Tile byte 1
0,1 CHR$(66) Tile byte 2
0,2 CHR$(36) Tile byte 3
0,3 CHR$(24) Tile byte 4
0,4 CHR$(24) Tile byte 5
0,5 CHR$(36) Tile byte 6
0,6 CHR$(66) Tile byte 7
0,7 CHR$(129) Tile byte 8

When supplied, <*background attribute*> specifies the "background tile slice" to skip when checking for boundary termination.

You cannot specify more than two consecutive bytes in the tile background slice that match the tile string. Specifying more than two will result in an "Illegal function call" error.

Example:

```
10 CIRCLE (15, 15), 10, 1
20 PAINT (15, 15), 2, 1
```

begins painting at coordinates 15,15 with color 2 and border color 1, and fills to a border.

PEEK Function

Syntax: PEEK (*n*)

Purpose: To return the byte read from the indicated memory location (*n*).

Remarks: The returned value is an integer in the range 0 to 255. n must be in the range −32768 to 65535. n is the offset from the current segment, which was defined by the last DEF SEG statement. For the interpretation of a negative value of n, see VARPTR Function.

PEEK is the complementary function of the POKE statement.

Example:

```
A = PEEK(&H5A00)
```

In this example, the value at the location with the hex address 5A00 is loaded into a variable, A.

PEN ON, PEN OFF, PEN STOP Statements

Syntax:

PEN ON
PEN OFF
PEN STOP

Purpose:

The PEN ON statement enables the lightpen read function and event trapping.

The PEN OFF statement disables the lightpen read function and event trapping.

The PEN STOP statement disables the lightpen read function and event trapping but remembers a PEN event so that it can be trapped as soon as event trapping is enabled.

Remarks:

The pen is initially off. A PEN ON statement must be executed before any pen read function calls (see PEN Function) can be made. If the function is called when the pen is off, an "Illegal function call" error will result.

PEN ON also enables event trapping by an ON PEN statement. For a full discussion of pen event trapping, see ON PEN Statement.

On some machines, the pen should not be used in the border area of the screen. Any values returned while the pen is in that area will be inaccurate.

To speed program execution, the pen should be turned off with a PEN OFF statement for programs not using the lightpen.

Example 1:

```
10 PEN ON 'enables lightpen read function and event trap
```

Example 2:

```
20 PEN OFF 'disables lightpen read function and event trap
```

PEN Function

Syntax: PEN (*n*)

(*n*) is a numeric expression returning an unsigned integer in the range 0 to 9 (see below).

The x = PEN (*n*) function reads the light pen coordinates, where n is:

0 - If pen was down since last poll, returns −1, 0 if not.

1 - Returns the x pixel coordinate where pen was last pressed.

2 - Returns the y pixel coordinate where pen was last pressed.

3 - Returns the current pen switch value: −1 if down, 0 if up.

4 - Returns the last known valid x pixel coordinate.

5 - Returns the last known valid y pixel coordinate.

6 - Returns the character row position where pen was last *pressed*.

7 - Returns the character column position where pen was last *pressed*.

8 - Returns the last known character row where the pen was *positioned*.

9 - Return the last known valid character column where the pen was *positioned*.

Example:

```
5 CLS
10 PEN ON
20 P = PEN(3)
30 LOCATE 1,1 :PRINT "PEN IS";
40 IF P THEN PRINT "DOWN" ELSE PRINT
"UP"
50 GOTO 20
```

This example produces an endless loop to print the current pen switch status (UP/DOWN).

PLAY Statement

Syntax: PLAY <*string*>

<*string*> is one or more of the subcommands listed under "Remarks."

Purpose: To play music as specified by <*string*>.

Remarks: PLAY uses a concept similar to that in DRAW by embedding a Music Macro Language into one statement. A set of subcommands, used as part of the PLAY statement, specifies the particular action to be taken.

Prefixes-Change Octave

> Increments octave. Octave will not advance beyond 6.

< Decrements octave. Octave will not drop below 0.

Tone

C<*n*> Sets the current octave. There are seven octaves, numbered 0 through 6.

A-G Plays a note in the range A-G. # or + after the note specifies sharp; – specifies flat.

N<*n*> Plays note n. *n* may range from 0 through 84 (in the 7 possible octaves, there are 84 notes). n = 0 means a rest.

Duration

L<*n*> Sets the length of each note. L 4 is a quarter note, L 1 is a whole note, etc. n may be in the range 1 through 64.

The length may also follow the note when a change of length only is desired for a particular note. In this case, A 16 is equivalent to L 16 A.

MN Sets "music normal" so that each note will play 7/8 or the time determined by the length (L).

ML Sets "music legato" so that each note will play the full period set by length (L).

MS Sets "music staccato" so that each note will play 3/4 of the time determined by the length (L).

Tempo

P<*n*> Specifies a pause, ranging from 1 through 64. This option corresponds to the length of each note, set with L <*n*>.

T<*n*> Sets the "tempo," or the number of L 4's in one minute. *n* may range from 32 through 255. The default is 12C.

Operation

MF Sets music (PLAY statement) and SOUND to run in the foreground. That is, each subsequent note or sound will not start until the previous note or sound has finished. This is the default setting.

MB Music (PLAY statement) and SOUND are set to run in the background. That is, each note or sound is placed in a buffer allowing the GW-BASIC program to continue executing while the note or sound plays in the background.

Substring

X. *<string>*

Executes a substring. Because of the slow clock interrupt rate, some notes will not play at higher tempos (L 64 at T 255, for example).

Note (as shown in the "Examples" below) that a substring may be executed by appending the character form of the substring address to "X".

Suffixes

or + follows a specified note, and turns it into a sharp.

– follows a specified note, and turns it into a flat.

A period after a note causes the note to play 3/2 times the length determined by L multiplied by T (tempo). Multiple periods may appear after a note. The period is scaled accordingly; for example, A. is 3/2, A.. is 9/4, A... is 27/8, etc. Periods may appear after a pause (P). In this case, the pause length may be scaled in the same way notes are scaled.

Notes: In all these commands n can be either a constant or a variable. A semicolon (;) must be inserted if you specify variables as parameter of n. A semicolon is also required if you see X command. Using semicolons is not valid after MF, MB MN or MS command.

Because of the slow clock interrupt rate, some notes will not play at higher tempos (L64 at T255, for example).

Examples:

```
PLAY "< <" 'Decrement by two octaves

PLAY ">" 'Increment by an octave

PLAY ">A" 'Increment by an octave and play an A
note

PLAY "XSONG$"

LET LISTEN$ = "T180 O2 P2 P8 L8 GGG L2 E-"

LET FATE$ = "P24 P8 L8 FFF L2 D"

PLAY LISTEN$ + FATE$
```

This example will play the beginning of the first movement of Beethoven's Fifth Symphony.

PLAY Function

Syntax: PLAY (*n*)

(*n*) is a dummy argument and may be any value.

Purpose: To return the number of notes currently in the background music queue.

Remarks: PLAY (*n*) will return 0 when the user is in Music Foreground Mode.

PLAY ON, PLAY OFF, PLAY STOP Statements

Syntax:

PLAY ON
PLAY OFF
PLAY STOP

Purpose:

PLAY ON enables play event trapping. PLAY OFF disables play event trapping. PLAY STOP suspends play event trapping.

Remarks:

If a PLAY OFF statement has been executed the GOSUB is not performed and is not remembered.

If a PLAY STOP statement has been executed the GOSUB is not performed, but will be performed as soon as a PLAY ON statement is executed.

When an event trap occurs (i.e., the GOSUB is performed), an automatic PLAY STOP is executed so that recursive traps cannot take place. The RETURN from the trapping subroutine will automatically perform a PLAY ON statement unless an explicit PLAY OFF was performed inside the subroutine.

The RETURN <*line number*> form of the RETURN statement may be used to return to a specific line number from the trapping subroutine. Use this type of return with care, however, because any other GOSUBs, WHILEs or FORs that were active at the time of the trap will remain active, and errors such as "FOR without NEXT" may result.

PMAP Function

Syntax: PMAP (<*expression*>, <*function*>)

Purpose: To map world coordinate expressions to physical locations or to map physical expressions to a world coordinate location.

<*function*> =

0: Maps world expression to physical x coordinate.

1: Maps world expression to physical y coordinate.

2: Maps physical expression to world x coordinate.

3: Maps physical expression to world y coordinate.

Remarks: The four PMAP functions allow the user to find equivalent point locations between the world coordinates created with the WINDOW statement and the physical coordinate system of the screen or viewport as defined by the VIEW statement.

Example: If a user had defined a WINDOW SCREEN (80,100)—(200,200) then the upper left coordinate of the window would be (80,100) and the lower right would be (200,200). The screen coordinates may be (0,0) in the upper left hand corner and (639,199) in the lower right. Then:

```
X = PMAP(80,0)
```

would return the screen x coordinate of the window x coordinate 80:

```
0
```

The PMAP function in the statement:

```
Y = PMAP(200,1)
```

would return the screen y coordinate of the window y coordinate 200:

```
199
```

The PMAP function in the statement:

```
X = PMAP(639,2)
```

would return the "world" x coordinate that corresponds to the screen or viewport x coordinate 639:

```
200
```

The PMAP function in the statement:

```
Y = PMAP(100,3)
```

would return the "world" y coordinate that corresponds to the screen or viewport y coordinate 100:

```
150,2513
```

POINT Function

Syntax: POINT (<*xcoordinate*>,<*ycoordinate*>)

<*xcoordinate*> and <*ycoordinate*> are the coordintates of the pixel that is to be referenced.

or

POINT (<*function*>)

Purpose: POINT (x,y) allows the user to read the color number of a pixel from the screen. If the specified point is out of range, the value −1 is returned.

POINT with one argument allows the user to retrieve the current Graphics cursor coordinates. Therefore:

x = POINT (<*function*>) returns the value of the current x or y Graphics accumulator as follows:

function =

0 Returns the current physical x coordinate.

1 Returns the current physical y coordinate.

2 Returns the current logical x coordinate. If the WINDOW statement has not been used, this will return the same value as the POINT(0) function.

3 Returns the current logical y coordinate if WINDOW is active, else returns the current physical y coordinate as in 1 above.

where the physical coordinate is the coordinate on the screen or current viewport.

Examples:

```
10 SCREEN 1
20 LET C=3
30 PSET (10,10),C
40 IF POINT(10,10) =C THEN PRINT "This point
is color ";C

5 SCREEN 2
10 IF POINT(i,i)<>0 THEN PRESET (i,i) ELSE
PSET (i,i) 'invert current state of a point
20 PSET (i,i),1-POINT(i,i) 'another way to invert a
point if the system is black and white.
```

POKE Statement

Syntax: POKE *i,j*
where *i* and *j* are integer expressions.

Purpose: To write a byte into a memory location.

Remarks: *i* and *j* are integer expressions. The expression i represents the address of the memory location and j is the data byte. *j* must be in the range 0 to 255.

i must be in the range −32768 to 65535. *i* is the offset from the current segment, which was set by the last DEF SEG statement. For interpretation of negative values of *i*, see VARPTR Function.

The complementary function to POKE is PEEK.

WARNING

Use POKE carefully. If it is used incorrectly, it can cause GW-BASIC or MS-DOS to crash.

Example:

```
10 POKE &H5A00,&HFF
```

POS Function

Syntax: POS (*i*)

Purpose: To return the current horizontal (column) position of the cursor.

Remarks: The leftmost position is 1. *i* is is a dummy argument. To return the current vertical line position of the cursor, use the CSRLIN function.

Example:

```
IF POS(X)>60 THEN BEEP
```

Also see LPOS Function.

PRESET Statement

Syntax: PRESET
[step] (<*x-coordinate*>, <*y-coordinate*>)
[,<*color*>]

<*x-coordinate*> and <*y-coordinate*> specify the pixel that is to be set.

<*color*> is the color number that is to be used for the specified point.

The STEP option, when used, indicates the given x and y coordinates will be relative, not absolute. That means the x and y are distances from the most recent cursor location, not distances from the (0,0) screen coordinate.

Purpose: To draw a specified point on the screen. PRESET works exactly like PSET except that if the <*color*> is not specified, the background color is selected.

Remarks: If a coordinate is outside the current viewport, no action is taken, nor is an error message given.

Coordinates can be shown as absolutes, as in the above syntax, or the STEP option can be used to reference a point relative to the most recent point used. For example, if the most recent point referenced were (10,10), STEP (10,5) would reference the point at (20,15).

Example:

```
5 REM DRAW A LINE FROM (0,0) TO
(100,100)
10 FOR I=0 TO 100
20 PRESET (I,I), 1
30 NEXT
35 PSET (100,100)
40 FOR I=0 TO 100
50 PRESET STEP (-1,-1)
60 NEXT
```

This example draws a line from (0,0) to (100,100) and then erases that line by overwriting it with the background color.

Also see PSET statement.

PRINT Statement

Syntax: PRINT [<*list of expressions*>] [;]

Purpose: To output data on the screen.

Remarks: If <*list of expressions*> is omitted, a blank line is printed. If <*list of expressions*> is included, the values of the expressions are printed on the screen. The expressions in the list may be numeric and/or string expressions. (String literals must be enclosed in quotation marks.)

A question mark (?) can be used as a form of shorthand by the user. It will be interpreted as the word "PRINT", and will appear as "PRINT" in subsequent listings.

Print Positions

The position of each printed item is determined by the punctuation used to separate the items in the list. Microsoft GW-BASIC divides the line into print zones of 14 spaces each. In the list of expressions, a comma causes the next value to be printed at the beginning of the next zone. Semicolon causes the next value to be printed immediately after the last value. Typing one or more spaces between expressions has the same effect as typing a semicolon.

If a comma or a semicolon terminates the list of expressions, the next PRINT statement begins printing on the same line, spacing according to instructions. If the list of expressions terminates without a comma or a semicolon, a carriage return is printed at the end of the line. If the printed line is wider than the screen width, Microsoft GW-BASIC goes to the next physical line and continues printing.

Printed numbers are always followed by a space. Positive numbers are preceded by a space. Negative numbers are preceded by a minus sign. Single precision numbers that can be represented with 6 or fewer digits in the unscaled format no less accurately than they can be represented in the scaled format, are output using the unscaled format. For example, 1E-7 is output as .0000001 and 1E-8 is output as 1E-08. Double precision numbers that can be represented with 16 or fewer digits in the unscaled format no less accurately than they can be represented in the scaled format, are output using the unscaled format. For example, 1D-15 is output as .0000000000000001 and 1D-16 is output as 1D-16.

With the interpreter, a question mark may be used in place of the word PRINT in a PRINT statement.

Example 1:

```
10 X = 5
20 PRINT X + 5,X-5,X*(-5),X^5
30 END
```

will yield

```
 10       0       -25       3125
```

In this example, the commas in the PRINT statement cause each value to be printed at the beginning of the next PRINT zone.

Example 2:

```
10 INPUT X
20 PRINT X "SQUARED IS" X^2 "AND";
30 PRINT X "CUBED IS" X^3
40 PRINT
50 GOTO 10
```

will yield

```
? 9
 9 SQUARED IS 81 AND 9 CUBED IS 729

? 21
 21 SQUARED IS 441 AND 21 CUBED IS 9261

?
```

In this example, the semicolon at the end of line 20 causes both PRINT statements to be printed on the same line. Line 40 causes a blank line to be printed before the next prompt.

Example 3:

```
10 FOR X = 1 TO 5
20 J = J + 5
30 K = K + 10
40 ?J;K;
50 NEXT X
```

will yield

```
 5   10   10   20   15   30   20   40   25   50
```

In this example, the semicolons in the PRINT statement cause each value to be printed immediately after the preceding value. (Remember, a number is always followed by a space, and positive numbers are preceded by a space.) In line 40, a question mark is used instead of the word PRINT.

PRINT USING Statement

Syntax: PRINT USING <*string exp*>;<*list of expressions*>[;]

Purpose: To print strings or numbers using a specified format.

Remarks/ Examples: <*list of expressions*> is comprised of the string expressions or numeric expressions that are to be printed separated by semicolons.

<*string exp*>is string literal (or variable) composed of special formatting characters. These formatting characters (see below) determine the field and the format of the printed strings or numbers.

String Fields

When PRINT USING is used to print strings, one of three formatting characters may be used to format the string field:

"!" Specifies that only the first character in the given string is to be printed.

" \ n spaces \ "

Specifies that 2 + n characters from the string are to be printed. If the backslashes are typed with no spaces, two characters will be printed; with one space, three characters will be printed, and so on. If the string is longer than the field, the extra characters are ignored. If the field is longer than the string, the string will be left-justified in the field and padded with spaces on the right.

Example:

```
10 A$ = "LOOK":B$ = "OUT"
30 PRINT USING "!";A$;B$
40 PRINT USING "\   \";A$;B$
50 PRINT USING "\   \";A$;B$;"!!"
```

will yield

```
LO
LOOKOUT
LOOKOUT !!
```

"&" Specifies a variable length string field. When the field is specified with "&", the string is output without modification.

Example:

```
10 A$ = "LOOK":B$ = "OUT"
20 PRINT USING "!";A$;
30 PRINT USING "&";B$
```

will yield

```
LOUT
```

Numeric Fields

When PRINT USING is used to print numbers, the following special characters may be used to format the numeric field:

A number sign is used to represent each digit position. Digit positions are always filled. If the number to be printed has fewer digits than positions specified, the number will be right-justified (preceded by spaces) in the field.

A decimal point may be inserted at any position in the field. If the format string specifies that a digit is to precede the decimal point, the digit will always be printed (as 0, if necessary). Numbers are rounded as necessary.

```
PRINT USING "# #.# #";.78
 0.78
```

```
PRINT USING "# # #.# #";987.654
987.65

PRINT USING "# #.# #";10.2,5.3,66.789,.234
10.20  5.30  66.79  0.23
```

In the last example, three spaces were inserted at the end of the format string to separate the printed values on the line.

+ A plus sign at the beginning or end of the format string will cause the sign of the number (plus or minus) to be printed before or after the number.

– A minus sign at the end of the format field will cause negative numbers to be printed with a trailing minus sign.

```
PRINT USING "+ # #.# #"; -68.95,2.4,55.6,-.9
-68.95 +2.40 +55.60 -0.90

PRINT USING "# #.# #";-68.95,22.449,-7.01
68.95-  22.45  7.01-
```

****** A double asterisk at the beginning of the format string causes leading spaces in the numeric field to be filled with asterisks. The ** also specifies positions for two more digits.

```
PRINT USING "**#.# ";12.39,-0.9,765.1
*12.4 *-0.9  765.1
```

$$ A double dollar sign causes a dollar sign to be printed to the immediate left of the formatted number. The $$ specifies two more digit positions, one of which is the dollar sign. The exponential format cannot be used with $$. Negative numbers cannot be used unless the minus sign trails to the right.

```
PRINT USING "$$# # #.# #";456.78
 $456.78
```

**$ The **$ at the beginning of a format string combines the effects of the above two symbols. Leading spaces will be asterisk-filled and a dollar sign will be printed before the number. **$ specifies three more digit positions, one of which is the dollar sign.

The exponential format cannot be used with **$. When negative numbers are printed, the minus sign will appear immediately to the left of the dollar sign.

```
PRINT USING "**$# #.# #";2.34
***$2.34
```

A comma that is to the left of the decimal point in a formatting string causes a comma to be printed to the left of every third digit to the left of the decimal point. A comma that is at the end of the format string is printed as part of the string. A comma specifies another digit position. The comma has no effect if used with exponential (^^^^) format.

```
PRINT USING "# # # #,.# #";1234.5
1,234.50
```

```
PRINT USING "# # # #.# #,";1234.5
1234.50,
```

^^^^ Four carets (or up-arrows) may be placed after the digit position characters to specify exponential format. The four carets allow space for E+xx to be printed. Any decimal point position may be specified. The significant digits are left-justified, and the exponent is adjusted. Unless a leading + or trailing + or – is specified, one digit position will be used to the left of the decimal point to print a space or a minus sign.

```
PRINT USING "# #.# #^^^^";234.56
 2.35E+02
```

```
PRINT USING ".####^^^^-";-888888
 .8889E+06-

PRINT USING "+.##^^^^";123
+.12E+03
```

An underscore in the format string causes the next character to be output as a literal character.

```
PRINT USING "_!##.##_!";12.34
!12.34!
```

The literal character itself may be an underscore by placing "__" in the format string.

% If the number to be printed is larger than the specified numeric field, a percent sign is printed in front of the number. If rounding causes the number to exceed the field, a percent sign will be printed in front of the rounded number.

```
PRINT USING "##.##";111.22
%111.22

PRINT USING ".##;.999
%1.00
```

If the number of digits specified exceeds 24, an "Illegal function call" error will result.

PRINT # And PRINT # USING Statements

Syntax: PRINT # <*file number*>,[USING <*string exp*>;] <*list of expressions*>

Purpose: To write data to a sequential file.

Remarks/: Examples: <*file number*> is the number used when the file was opened for output. <*string exp*> consists of formatting characters as described in "PRINT USING Statement." The expressions in <*list of expressions*> are the numeric and/or string expressions that will be written to the file.

PRINT # does not compress data. An image of the data is written to the file, just as it would be displayed on the terminal screen with a PRINT statement. For this reason, care should be taken to delimit the data, so that it will be input correctly.

In the list of expressions, numeric expressions should be delimited by semicolons. For example:

```
PRINT #1,A;B;C;X;Y;Z
```

(If commas are used as delimiters, the extra blanks that are inserted between print fields will also be written to the file.)

String expressions must be separated by semicolons in the list. To format the string expressions correctly in the file, use explicit delimiters in the list of expressions.

For example, let A$ = "CAMERA" and B$ = "93604-1". The statement

```
PRINT #1,A$;B$
```

would write CAMERA93604-1 to the file. Because there are no delimiters, this could not be input as two separate strings. To correct the problem, insert explicit delimiters into the PRINT # statement as follows:

```
PRINT #1,A$;",";B$
```

The image written to the file is

```
CAMERA,93604-1
```

which can be read back into two string variables.

If the strings themselves contain commas, semicolons, significant leading blanks, carriage returns, or linefeeds, write them to the file surrounded by explicit quotation marks, CHR$(34).

For example, let A$ = "CAMERA, AUTOMATIC" and B$ = " 93604-1". The statement

```
PRINT #1,A$;B$
```

would write the following image to file:

```
CAMERA, AUTOMATIC 93604-1
```

And the statement

```
INPUT #1,A$,B$
```

would input "CAMERA" to A$ and "AUTOMATIC 93604-1" to B$. To separate these strings properly in the file, write double quotation marks to the file image using CHR$(34). The statement

```
PRINT # 1,CHR$(34);A$;CHR$(34);CHR$(34);B$
;CHR$(34)
```

writes the following image to the file:

"CAMERA, AUTOMATIC"" 93604-1"

And the statement

```
INPUT # 1,A$,B$
```

would input "CAMERA, AUTOMATIC" to A$ and " 93604-1" to B$.

The PRINT # statement may also be used with the USING option to control the format of the file. For example:

```
PRINT # 1,USING"$$# # #.# #,";J;K;L
```

Note: See also WRITE # Statement.

PSET Statement

Syntax: PSET [STEP] (<*x-coordinate*>,<*y-coordinate*>) [,<*color*>]

(<*x-coordinate*> and <*y-coordinate*>) specify the point on the screen to be colored.

<*color*> is the number of the color to be used.

The STEP option, when used, indicates the given x and y coordinates will be relative, not absolute. That means the x and y are distances from the most recent cursor location, not distances from the (0,0) screen coordinate.

Remarks: When GW-BASIC scans coordinate values, it will allow them to be beyond the edge of the screen. However, values outside the integer range −32768 to 32767 will cause an "Overflow" error.

Coordinates can be shown as offsets by using the STEP option to reference a point relative to the most recent point used. The syntax of the STEP option is:

STEP (<*x-offset*>, <*y-offset*>)

For example, if the most recent point referenced were (0,0), PSET STEP (10,0) would reference a point at offset 10 from x and offset 0 from y.

The coordinate (0,0) is always the upper left corner of the screen.

PSET allows the <*color*> to be left off the command line. If it is omitted, the default is the foreground color.

Note: Difference between the command PSET and PRESET is as follows; When the <*color*> option is omitted, PSET selects the foreground color while PRESET selects the background color.

Example:

```
5 REM DRAW A LINE FROM (0,0) TO
(100,100)
10 FOR I=0 TO 100
20 PSET (I,I)
30 NEXT I
35 REM NOW ERASE THAT LINE
40 FOR I=0 TO 100
50 PSET STEP (-1,-1),0
60 NEXT I
```

This example draws a line from (0,0) to (100,100) and then erases that line by writing over it with the background color.

PUT Statement (File I/O)

Syntax: PUT [#]<*file number*>[,<*record number*>]

Purpose: To write a record from a random buffer to a random access file.

Remarks: <*file number*> is the number under which the file was opened. If <*record number*> is omitted, the record will assume the next available record number (after the last PUT or GET). The smallest record number is 1.

The GET and PUT statements allow fixed-length input and output for GW-BASIC COM files. However, because of the low performance associated with telephone line communications, we recommend that you do not use GET and PUT for telephone communication.

Note: LSET, RSET, PRINT#, PRINT# USING, and WRITE# may be used to put characters in the random file buffer before executing a PUT statement.

In the case of WRITE#, Microsoft GW-BASIC pads the buffer with spaces up to the carriage return. Any attempt to read or write past the end of the buffer causes a "Field overflow" error.

For details on file I/O, see Chapter 5, "Working with Files and Devices."

Example:

```
100 PUT 1, A$, B$, C$
```

PUT Statement (Graphics)

Syntax: PUT (*x1,y1*),<*array name*>[,*action verb*]

used with GET statement.

Purpose: The GET and PUT statements are used together to transfer graphic images to and from the screen.

The GET statement transfers the screen image bounded by the rectangle described by the specified points into the array.

The PUT statement transfers the image stored in the array onto the screen.

The <*action verb*> specifies the interaction between the stored image and the one already on the screen.

GET (*x1,y1*)—(*x2,y2*),<*array name*>

(*x1,y1*) in the PUT statement specifies the point where a stored image is to be displayed on the screen. The specified point is the coordinate of the top left corner of the image. If the image to be transferred is too large to fit in the current viewport, an "Illegal function call" error will result.

<*action verb*> is one of: PSET, PRESET, AND, OR, XOR.

PSET transfers the data point by point onto the screen. Each point has the exact color attribute it had when it was taken from the screen with a GET.

PRESET is the same as PSET except that a negative image (black on white) is produced.

AND is used when the image is to be transferred over an existing image on the screen. The resulting image is the product of the logical AND expression; points that had the same color in both the existing image and the PUT image will remain the same color, points that do not have the same color in both the existing image and the PUT image, will not.

OR is used to superimpose the image onto an existing image.

XOR is a special mode often used for animation. It causes the points on the screen to be inverted where a point exists in the array image. This behavior is exactly like that of the cursor. When an image is PUT against a complex background twice, the background is restored unchanged. This allows a user to move an object around the screen without erasing the background.

The default <*action verb*> is XOR.

AND

transferred value

existing value	0	1	2	3
0	0	0	0	0
1	0	1	0	1
2	0	0	2	2
3	0	1	2	3

OR

transferred value

existing value	0	1	2	3
0	0	1	2	3
1	1	1	3	3
2	2	3	2	3
3	3	3	3	3

XOR

transferred value

existing value	0	1	2	3
0	0	1	2	3
1	1	0	3	2
2	2	3	0	1
3	3	2	1	0

Remarks: One of the most useful things that can be done with GET and PUT is animation. Animation is performed as follows:

1. PUT the object(s) on the screen.

2. Recalculate the new position of the object(s).

3. PUT the object(s) on the screen a second time at the old location(s) (using XOR) to remove the old image(s).

4. Go to step 1, but this time PUT the object(s) at the new location.

Movement done this way will leave the background unchanged. Flicker can be cut down by minimizing the time between steps 4 and 1 and by making sure that there is enough time delay between 1 and 3. If more than one object is being animated, every object should be processed at once, one step at a time.

If it is not important to preserve the background, animation can be performed using the PSET action verb. The idea is to leave a border around the image when it is first gotten that is as large or larger than the maximum distance the object will move.Thus, when an object is moved, this border will effectively erase any points left by the previous PUT. This method may be somewhat faster than the method using XOR described above, since only one PUT is required to move an object (although you must PUT a larger image).

It is possible to examine the x and y dimensions and even the data itself if an integer array is used. With the interpreter, the x dimension is in element 0 of the array, and the y dimension is found in element 1. (However, this will not always be true for the compiler.) Remember that integers are stored low byte first, then high byte, but the data is transferred high byte first (leftmost) and then low byte.

RANDOMIZE Statement

Syntax: RANDOMIZE [<*expression*>]

Purpose: To reseed the random number generator.

Remarks: If <*expression*> is omitted, Microsoft GW-BASIC suspends program execution and asks for a value by printing

Random Number Seed (−32768 to 32767)?

before executing RANDOMIZE.

If expression is a variable, the value of that variable is used to seed the random numbers.

If <*expression*> is the word "TIMER" then the TIMER function is used to pass a random number seed.

If the random number generator is not reseeded, the RND function returns the same sequence of random numbers each time the program is run. To change the sequence of random numbers every time the program is run, place a RANDOMIZE statement at the beginning of the program and change the argument with each run.

Example:

```
10 RANDOMIZE
20 FOR I = 1 TO 5
30 PRINT RND;
40 NEXT I
```

will yield

```
Random Number Seed (−32768 to 32767)? 3
```
(user types 3)

will yield

.885982 .4845668 .586328 .1194246 .7039225

Random Number Seed (−32768 to 32767)? 4
(user types 4 for new sequence)

will yield

.803506 .1625462 .929364 .2924443 .322921

Random Number Seed (−32768 to 32767)? 3
(same sequence as first run)

will yield

.885982 .4845668 .586328 .1194246 .7039225

Note that the numbers your program produces may not be the same as the ones shown here.

READ Statement

Syntax: READ *<list of variables>*

Purpose: To read values from a DATA statement and assign them to variables. (See DATA Statement.)

Remarks: A READ statement must always be used in conjunction with a DATA statement. READ statements assign variables to DATA statement values on a one-to-one basis. READ statement variables may be numeric or string, and the values read must agree with the variable types specified. If they do not agree, a "Syntax error" will result.

A single READ statement may access one or more DATA statements (they will be accessed in order), or several READ statements may access the same DATA statement. If the number of variables in *<list of variables>* exceeds the number of elements in the DATA statement(s), an "Out of data" error message is printed. If the number of variables specified is fewer than the number of elements in the DATA statement(s), subsequent READ statements will begin reading data at the first unread element. If there are no subsequent READ statements, the extra data is ignored.

To reread DATA statements from the start, use the RESTORE statement. (see RESTORE Statement)

Example 1:

```
.
.
.
80 FOR I = 1 TO 10
90 READ A(I)
100 NEXT I
110 DATA 3.08,5.19,3.12,3.98,4.24
120 DATA 5.08,5.55,4.00,3.16,3.37
.
.
.
```

This program segment READs the values from the DATA statements into the array A. After execution, the value of A(1) will be 3.08, A(2) will be 5.19 and so on.

Example 2:

```
10 PRINT "CITY","STATE", "ZIP"
20 READ C$,S$,Z$
30 DATA "DENVER,",
"COLORADO","80211"
40 PRINT C$,S$,Z$
```

will yield

```
CITY          STATE          ZIP
DENVER,       COLORADO       80211
```

This program reads string and numeric data from the DATA statement in line 30.

REM Statement

Syntax: REM [<*remark*>]

Purpose: To allow explanatory remarks to be inserted in a program.

Remarks: REM statements are not executed but are output exactly as entered when the program is listed.

REM statements may be branched into from a GOTO or GOSUB statement. Execution will continue with the first executable statement after the REM statement.

Remarks may be added to the end of a line by preceding the remark with a single quotation mark instead of REM.

Important: Do not use the single quotation form of the REM statement in a data statement, because it would be considered legal data.

Example:

```
.
.
.
120 REM CALCULATE AVERAGE VELOCITY
130 FOR I=1 TO 20
140 SUM=SUM + V(I)
.
.
.
```

or

```
.
.
.
120 FOR I = 1 TO 20 'CALCULATE
AVERAGE VELOCITY
130 SUM = SUM + V(I)
140 NEXT I
.
.
.
```

RENUM Command

Syntax: RENUM [<*new number*>] [,[<*old number*>] [,<*increment*>]]

Purpose: To renumber program lines.

Remarks: <*new number*> is the first line number to be used in the new sequence. The default is 10. <*old number*> is the line in the current program where renumbering is to begin. The default is the first line of the program. <*increment*> is the increment to be used in the new sequence. The default is 10.

RENUM also changes all line number references following GOTO, GOSUB, THEN, ON...GOTO, ON...GOSUB, and ERL statements to reflect the new line numbers. If a nonexistent line number appears after one of these statements, the error message "Undefined line xxxxx in yyyyy" is printed. The incorrect line number reference is not changed by RENUM, but line number yyyyy may be changed.

Note: RENUM cannot be used to change the order of program lines (for example, RENUM 15,30 when the program has three lines numbered 10, 20 and 30) or to create line numbers greater than 65529. An "Illegal function call" error will result.

Examples: RENUM

Renumbers the entire program. The first new line number will be 10. Lines will be numbered in increments of 10.

RENUM 300,,50

Renumbers the entire program. The first new line number will be 300. Lines will be numbered in increments of 50.

RENUM 1000,900,20

Renumbers the lines from 900 up so they start with line number 1000 and are numbered in increments of 20.

RESET Command

Syntax: RESET

Purpose: .To close all files.

Remarks: RESET closes all open files and forces all blocks in memory to be written to disk. Thus, if the machine loses power, all files will be properly updated.

All files must be closed before a disk is removed from its drive.

Example:

```
998 RESET
999 END
```

RESTORE Statement

Syntax: RESTORE [<*line number*>]

Purpose: To allow DATA statements to be reread from a specified line.

Remarks: After a RESTORE statement without a specified line number is executed, the next READ statement accesses the first item in the first DATA statement in the program.

If <*line number*> is specified, the next READ statement accesses the first item in the specified DATA statement.

Example:

```
10 READ A,B,C
20 RESTORE
30 READ D,E,F
40 DATA 57, 68, 79
50 PRINT A;B;C;D;E;F
```

will yield

```
 57 68 79 57 68 79
```

RESUME Statement

Syntax: RESUME

RESUME 0

RESUME NEXT

RESUME <*line number*>

Purpose: To continue program execution after an error recovery procedure has been performed.

Remarks: Any one of the four syntaxes shown above may be used, depending upon where execution is to resume:

RESUME or RESUME 0
Execution resumes at the statement that caused the error.

RESUME NEXT
Execution resumes at the statement immediately following the one that caused the error.

RESUME <*line number*>
Execution resumes at <*line number*>

A RESUME statement that is not in an error handling routine causes a "RESUME without error" message to be printed.

Example:

```
10 ON ERROR GOTO 900
.
.
.
900 IF (ERR = 230) AND (ERL = 90) THEN
PRINT "TRY AGAIN":RESUME 80
.
.
.
```

RETURN Statement

See GOSUB...RETURN Statements.

RIGHT$ Function

Syntax: RIGHT$ (*x$,n*)

Purpose: To return the rightmost n characters of string *x$*.

Remarks: If n is equal to the number of characters in *x$* (LEN(x$)), returns *x$*. If *n* = 0, the null string (length zero) is returned.

Example:

```
10 A$="DISK BASIC"
20 PRINT RIGHT$(A$,5)
```

will yield

```
BASIC
```

Also see the LEFT$ and MID$ functions.

RMDIR Statement

Syntax: RMDIR <*pathname*>

Purpose: To remove an existing directory.

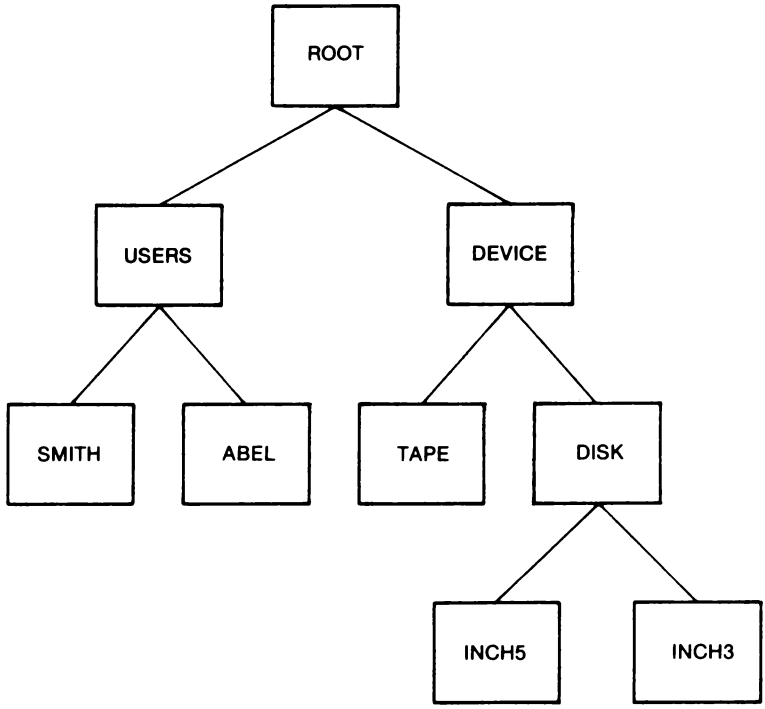
Remarks: *pathname* is the name of the directory which is to be deleted. RMDIR works exactly like the MS-DOS command RMDIR. The *pathname* must be a string of less than 63 characters.

The pathname to be removed must be empty of any files except the working directory('.') and the parent directory ('..') or else a "Path not found" or a "Path/File Access error" is given.

Example 1: RMDIR "\SALES"

In this statement, the SALES directory on the current drive is to be removed.

Example 2:



When you intend to remove directories in the above example, specify following form of commands:

from	remove	examples on the screen
DEVICE	INCH3	RMDIR "DISK \ INCH3"
DEVICE	DISK	RMDIR "DISK"
ROOT	DISK	RMDIR "DEVICE \ DISK"
ROOT	DEVICE	RMDIR "DEVICE"

When removing the directly DISK, INCH5 and INCH3 should have already been removed. Another cases are similar.

RND Function

Syntax: RND [(*x*)]

Purpose: To return a random number between 0 and 1.

Remarks: The same sequence of random numbers is generated each time the program is run unless the random number generator is reseeded (see "RANDOMIZE Statement"). However, *x* <0 always restarts the same sequence for any given x.

x > 0 or *x* omitted generates the next random number in the sequence. *x* = 0 repeats the last number generated.

Example:

```
10 FOR I = 1 TO 5
20 PRINT INT(RND*100);
30 NEXT I
```

might yield

```
 24 30 31 51 5
```

RUN Statement/Command

Syntaxes: RUN [<*line number*>]
RUN <*filespec*>[,R]

Purpose: To execute the program currently in memory, or to load a file into memory and run it.

Remarks: For a program currently in memory, if <*line number*> is specified, execution begins on that line. Otherwise, execution begins at the lowest line number. Microsoft GW-BASIC always returns to command level after a RUN statement is executed.

For running a program not in memory, the <*filespec*> is an optional device specification followed by a filename or pathname that conforms to MS-DOS's rules for filenames. BASIC appends the default filename extension ".BAS" if the user specifies no extensions, and the file has been saved to the disk.

RUN closes all open files and deletes the current contents of memory before loading the designated program. However, with the "R" option, all data files remain open.

Example:

```
RUN "NEWFIL",R
```

SAVE Command

Syntax: SAVE <*filespec*>[{,A |,P}]

Purpose: To save a program file.

Remarks: For saving a program in memory, the <*filespec*> is an optional device specification followed by a filename or pathname that conforms to MS-DOS's rules for filenames. BASIC appends the default filename extension ".BAS" if the user specifies no extensions, and the file has been saved to the disk.

The A option saves the file in ASCII format. If the A option is not specified, Microsoft GW-BASIC saves the file in a compressed binary format. ASCII format takes more space on the disk, but some actions require that files be in ASCII format. For instance, the MERGE command requires an ASCII format file, and some operating system commands such as TYPE may require an ASCII format file.

The P option protects the file by saving it in an encoded binary format. When a protected file is later RUN (or LOADed), any attempt to list or edit it will fail.

Examples: SAVE "COM2",A

Saves the program COM2 in ASCII format.

SAVE "PROG",P

Saves the program PROG.BAS as a protected file which cannot be altered.

SCREEN Statement

Syntax: SCREEN [<*mode*>] [,<*burst*>] [,[<*active page*>] [,<*display page*>]]]

<*mode*>: numerical expression indicating graphic resolution.

0: text mode at 40 or 80 characters wide.
1: Medium resolution graphics mode (320 x 200 dots).
2: High resolution graphics mode (640 x 200 dots).

<*burst*> is a numerical expression in 0 or others. It enables or disables color display.

mode = 0: 0 switches black and white image on the screen and other value enables color image.
mode = 1: 0 switches to color image on the screen and other value disables color image.
mode = 2: burst parameter has no effect in this mode.

<*active page*>: numerical expression with the value of 0 to 7 for 40 characters width or 0 to 3 for 80 characters width. Active page is one of the video RAM pages to where all screen output statements write or draw data. This option is valid only for the text mode.

<*display page*>: numerical expression with the value of 0 to 7 for 40 characters width or 0 to 3 for 80 characters width. Display page is one of the video RAM pages which is displayed to the screen. Specification for active page and display page may be different. If this parameter is omitted, display page is equal to active page. This option is also valid only for the text mode.

WARNING

The SCREEN command can be used only for the computer which has a color display board.

Remarks: If any parameter is omitted, old parameters except *<display page>* are assumed.

Examples: 10 SCREEN 1,0

Medium resolution color graphics is assigned.

20 SCREEN, 1

Mode is unchanged disabling color image.

30 SCREEN 2,0

High resolution graphics is assigned.

40 SCREEN 0,1,0,0

Text mode with color image, and active and display page are both 0.

50 SCREEN ,,2

Mode remains unchanged (text mode with color image), and active and display page are both 2.

SCREEN Function

Syntax: SCREEN (<*row*>,<*column*>[,*z*])

<*row*> is a valid numeric expression returning an unsigned integer.

<*column*> is a valid numeric expression returning an unsigned integer.

z is a valid numeric expression.

Purpose: To read a character or its color from a specified screen location.

Remarks: The ordinate of the character at the specified coordinates is stored in the numeric variable. If the optional parameter *z* is given and is non-zero, the color attribute for the character is returned instead.

Example:

```
100 X = SCREEN (10,10)
```

If the character at (10,10) is A, then the function would return 65, the ASCII code for A.

```
100 X = SCREEN (1,1,1)
```

Returns the color attribute of the character in the upper left corner of the screen.

SGN Function

Syntax: SGN (*x*)

Purpose: To indicate the value of *x*, relative to zero:

If $x>0$, SGN(x) returns 1.
If $x=0$, SGN(x) returns 0.
If $x<0$, SGN(x) returns -1.

Example:

```
ON SGN(X) +2 GOTO 100,200,300
```

Branches to 100 if *x* is negative, 200 if *x* is 0, and 300 if *x* is positive.

SHELL Statement

Syntax: SHELL [<*command-string*>]

Purpose: To exit the BASIC program, run a COM or EXE or BAT program, or a built in DOS function such as DIR or TYPE, and return to the BASIC program at the line after the SHELL statement.

Remarks: A COM, EXE, or BAT program or DOS function which runs under the SHELL statement is called a "Child process". By using COMMAND in this way, command line parameters are passed to the child. Standard input and output may be redirected, and built in commands such as DIR, PATH, and SORT may be executed.

The <*command-string*> must be a valid string expression containing the name of a program to run and (optionally) command arguments.

The program name in <*command-string*> may have any extension you wish. If no extension is supplied, COMMAND will look for a .COM file, then a .EXE file, and finally, a .BAT file. If COMMAND is not found, SHELL will issue a "File not found" error. No error is generated if COMMAND cannot find the file specified in <*command-string*>.

Any text separeted from the program name by at least one blank will be processed by COMMAND as program parameters.

BASIC remains in memory while the child process is running . When the child finishes, BASIC continues.

GW-BASIC will not allow the user to SHELL to another copy of BASIC. BASIC, when run as a Child process, will recognize this before initialization and return to the Parent copy of BASIC after issuing the Message: "You cannot Shell to BASIC". This restriction is provided as an implementaion option for cases where it is necessary to protect the integrity of the BASIC Parent.

SHELL with no <*command-string*> will give you a new COMMAND shell. You may now do anything that COMMAND allows. When ready to return to BASIC, enter the DOS command: EXIT

Examples:

```
SHELL 'get a new COMMAND

A>DIR     (user types DIR to see files)

A>EXIT    (user types EXIT to return to BASIC)

OK        'now back in BASIC
```

Write some data to be sorted, use SHELL to sort it, then read the sorted data to write a report.

```
900 OPEN "SORTIN.DAT" FOR OUTPUT AS 1
⋮ (write data to be sorted)
1000 CLOSE 1
1010 SHELL "SORT SORTIN.DAT
SORTOUT.DAT"
1020 OPEN "SORTOUT.DAT" FOR INPUT AS 1
1030 REM **Process the sorted data
⋮
```

Also see "BASIC and Child Processes".

SIN Function

Syntax: SIN (*x*)

Purpose: To return the sine of *x*, where *x* is in radians.

Remarks: COS(X) = SIN(X + 3.14159/2)

Example: PRINT SIN(1.5)

will yield

.9974951

See also COS Function.

SOUND Statement

Syntax: SOUND <*freq*>,<*duration*>

<*freq*> is the desired frequency in hertz. This must be a numeric expression returning an unsigned integer.

<*duration*> is the duration in clock ticks. Clock ticks occur 18.2 times per second. This must be a numeric expression returning an unsigned integer in the range 0 to 2981.

Purpose: To generate a sound through the speaker.

Remarks: If the duration is zero, any current SOUND statement that is running will be turned off. If no SOUND statement is currently running, a SOUND statement with a duration of zero will have no effect.

	Tempo	Beats/ Minute	Ticks/ Beat
very slow	Larghissimo		
↓	Largo	40-60	27.3-18.2
↓	Larghetto	60-66	18.2-16.55
↓	Grave		
↓	Lento		
↓	Adagio	66-76	16.55-14.37
slow	Adagietto		
↓	Andante	76-108	14.37-10.11
medium	Andantino		
↓	Moderato	108-120	10.11-9.1
fast	Allegretto		
↓	Allegro	120-168	9.1-6.5
↓	Vivace		
↓	Veloce		
↓	Presto	168-208	6.5-5.25
very fast	Prestissimo		

Note	Frequency	Note	Frequency
C	130.810	C*	523.250
D	146.830	D	587.330
E	164.810	E	659.260
F	174.610	F	698.460
G	196.000	G	783.990
A	220.000	A	880.000
B	246.940	B	987.770
C	261.630	C	1046.500
D	293.660	D	1174.700
E	329.630	E	1318.500
F	349.230	F	1396.900
G	392.000	G	1568.000
A	440.000	A	1760.000
B	493.880	B	1975.500

*middle C. Higher (or lower) notes may be approximated by doubling (or halving) the frequency of the corresponding note in the previous (next) octave.

To create periods of silence, use SOUND 32767, *duration*.

Example: 30 SOUND RND*1000+37,2

This statement creates random sounds.

37 -32,00

SPACE$ Function

Syntax: SPACE$ (*n*)

Purpose: To return a string of spaces of length *n*.

Remarks: The expression *n* is rounded to an integer and must be in the range 0 to 255.

Example:

```
10 FOR I=1 TO 5
20       X$=SPACE$(I)
30       PRINT X$;I
40 NEXT I
```

will yield

```
 1
  2
   3
    4
     5
```

Also see SPC Function.

SPC Function

Syntax: SPC (*n*)

Purpose: To skip spaces in a PRINT statement. n is the number of spaces to be skipped.

Remarks: SPC may only be used with PRINT and LPRINT statements. *n* must be in the range 0 to 255. If *n* is larger than 80, a remainder of the expression *n*/80 is assumed; i.e. when *n* is 163, three spaces will be generated.
A ';' is assumed to follow the SPC (*n*) command.

Example: PRINT "OVER" SPC(15) "THERE"

will yield

OVER THERE

Also see SPACE$ Function.

SQR Function

Syntax: SQR (*x*)

Purpose: To return the square root of *x*.

Remarks: *x* must be > = 0.

Example:

```
10 FOR X = 10 TO 25 STEP 5
20       PRINT X, SQR(X)
30 NEXT X
```

will yield

```
 10        3.162278
 15        3.872984
 20        4.472136
 25        5
```

STICK Function

Syntax: STICK (*n*)

n is a numeric variable for storing the result of the function.

(*n*) is a numeric expression returning an unsigned integer in the range 0 to 3.

Purpose: To feturn the x and y coordinates of the two joysticks.

Remarks: The values returned for n can be:

0 - returns the x coordinate for joystick A. Also stores the x and y values for both joysticks for the following function calls:

1 - Returns the y coordinate of joystick A.

2 - Returns the x coordinate of joystick B.

3 - Returns the y coordinate of joystick B.

Example:

```
10 CLS
20 LOCATE 1,1
30 PRINT "Y = ";STICK (0)
40 PRINT "Y = ";STICK (1)
50 GOTO 20
```

This example creates an endless loop to diaplay the value of the x,y coordinate for joystick A.

STOP Statement

Syntax: STOP

Purpose: To terminate program execution and return to command level.

Remarks: STOP statements may be used anywhere in a program to terminate execution. STOP is often used for debugging. When a STOP is encountered, the following message is printed:

Break in line nnnnn

The STOP Statement does not close files.

Microsoft GW-BASIC always returns to command level after a STOP is executed. Execution is resumed by issuing a CONT command.

Example:

```
10 INPUT A,B,C
20 K=A ^2*5.3:L=B ^3/.26
30 STOP
40 M=C*K+100:PRINT M
```

will yield

```
? 1,2,3
BREAK IN 30

PRINT L
 30.76923
CONT
 115.9
```

STR$ Function

Syntax: STR$ (*n*)

Purpose: To return a string representation of the value of *n*.

Example:

```
5 REM ARITHMETIC FOR KIDS
10 INPUT "TYPE A NUMBER";N
20 ON LEN(STR$(N)) GOSUB 30,100,200,300,
400,500
.
.
.
```

In this example, if N is in one digit, execution branches to line number 100. If N is in two digits, branches to 200 and so on. If N is more than six characters, execution branches to line 30.

```
PRINT LEN (STR$ (1))
```

will yield

```
 2
```

Because numeric value always has plus (+) or minus (−) sign ahead that value. This plus sign is not displayed, however, encountered as a digit.

STRIG Function

Syntax: STRIG (*n*)

(*n*) is a numeric expression returning an unsigned integer in the range 0 to 3, designating which trigger is to be checked.

Purpose: To return the status of a specified joystick trigger.

Remarks: In the STRG (*n*) function, the values returned for (*n*) can be:

0 - Returns −1 if trigger A was pressed since the last STRIG(0) statement; returns 0 if not.

1 - Returns −1 if trigger A is currently down, 0 if not.

2 - Returns −1 if trigger B was pressed since the last STRIG(2) statement; returns 0 if not.

3 - Returns −1 if trigger B is currently down, 0 if not.

When a joystick event trap occurs, that occurrence of the event is destroyed. Therefore, the x = STRIG (*n*) function will always return false inside a subroutine, unless the event has been repeated since the trap. So if you wish to perform different procedures for various joysticks, you must set up a different subroutine for each joystick, rather than including all the procedures in a single subroutine.

Example:

```
10 IF STRIG (0) THEN BEEP
20 GOTO 10
```

In this example an endless loop is created to beep whenever the trigger button on joystick 0 is pressed.

STRIG ON, STRIG OFF, STRIG STOP Statements

Syntax:

STRIG ON
STRIG OFF
STRIG STOP

Purpose:

The STRIG ON statement enables event trapping of joystick activity.

The STRIG OFF statement disables event trapping of joystick activity.

The STRIG STOP statement disables event trapping of joystick activity.

Remarks:

The STRIG ON statement enables joystick event trapping by an ON STRIG statement (see STRIG Statement). While trapping is enabled, and if a non-zero line number is specified in the ON STRIG statement, GW-BASIC checks between every statement to see if the joystick trigger has been pressed.

The STRIG OFF statement disables event trapping. If a subsequent event occurs (i.e., if the trigger is pressed), it will not be remembered when the next STRIG ON is invoked.

The STRIG STOP statement disables event trapping, but if an event occurs it will be remembered, and the event trap will take place as soon as trapping is reenabled.

STRING$ Function

Syntax: STRING$ (*i,j*)
STRING$ (*i,x$*)

Purpose: To return a string of length *i* whose characters all have ASCII cord *j* or the first character of *x$*.

Examples:

```
10 DASH$ = STRING$ (10,45)
20 PRINT DASH$;"MONTHLY
REPORT";DASH$
```

will yield

```
---------- MONTHLY REPORT ----------
```

```
10 LET A$ = "HOUSTON"
20 LET X$ = STRING$(8,A$)
30 PRINT X$
```

will yield

```
HHHHHHHH
```

SWAP Statement

Syntax: SWAP <*variable*>,<*variable*>

Purpose: To exchange the values of two variables.

Remarks: Any type variable may be swapped (integer, single precision, double precision, string), but the two variables must be of the same type or a "Type mismatch" error results.

If the second variable is not already defined when SWAP is executed, an "Illegal function call" error will result.

Example:

```
10 A$=" ONE " :B$=" ALL " :C$="FOR "
20 PRINT A$ C$ B$
30 SWAP A$,B$
40 PRINT A$ C$ B$
```

will yield

```
ONE FOR ALL
ALL FOR ONE
```

SYSTEM Command

Syntax: SYSTEM

Purpose: To close all open files and return control to the operating system.

Remarks: When a SYSTEM command is executed, all files are closed, and BASIC performs an exit to the operating system.

TAB Function

Syntax: TAB (*n*)

Purpose: To move the print position to *n*.

Remarks: If the current print position is already beyond space n, TAB goes to that position on the next line. Space 1 is the leftmost position, and the rightmost position is the width minus one. *n* must be in the range 1 to 255. TAB may only be used in PRINT, PRINT # and LPRINT statements.

Example:

```
10 PRINT "NAME" TAB(25) "AMOUNT" :PRINT
20 READ A$,B$
30 PRINT A$ TAB(25) B$
40 DATA "G. T. JONES","$25.00"
```

will yield

```
NAME                    AMOUNT

G. T. JONES             $25.00
```

TAN Function

Syntax: TAN (*x*)

Purpose: To return the tangent of *x*. *x* should be given in radians.

Remarks: With the interpreter, if TAN overflows, the "Overflow" error message is displayed, machine infinity with the appropriate sign is supplied as the result, and execution continues.

Example:

```
10 Y=Q*TAN(X)/2
```

TIME$ Statement

Syntax: TIME$ = <*string expression*>

<*string expression*> returns a string in one of the following forms:

hh (sets the hour ; minutes and seconds default to 00)

hh:mm (sets the hour and minutes; seconds default to 00)

hh:mm:ss (sets the hour, minutes, and seconds)

Purpose: To set the time. This statement complements the TIME$ function, which retrieves the time.

Remarks: A 24-hour clock is used; 8:00 p.m., therefore, would be entered as 20:00:00.

Example: 10 TIME$ = "08:00:00"

The current time is set at 8:00 a.m.

TIME$ Function

Syntax: TIME$

Purpose: To retrieve the current time. (To set the time, use the TIME$ statement.)

Remarks: The TIME$ function returns an eight-character string in the form hh:mm:ss, where hh is the hour (00 through 23), mm is minutes (00 through 59), and ss is seconds (00 through 59). A 24-hour clock is used; 8:00 p.m., therefore, would be shown as 20:00:00.

Example:

```
10 PRINT TIME$
```

Prints the time, calculated from the time set with the TIME$ statement.

TIMER Function

Syntax: TIMER

Purpose: To return the single-precision floating-point number representing the elapsed number of seconds since midnight or system reset.

Remarks: Fraction of seconds are calculated to the nearest degree possible.

TIMER ON, TIMER OFF, TIMER STOP Statements

Syntax:

TIMER ON
TIMER OFF
TIMER STOP

Purpose:

TIMER ON enables event trapping during real time.
TIMER OFF disables event trapping during real time.
TIMER STOP suspends real time event trapping.

Remarks:

The TIMER ON statement enables real time event trapping by an ON TIMER statement (see "ON TIMER Statement"). While trapping is enabled with the ON TIMER statement, GW-BASIC checks between every statement to see if the timer has reached the specified level. If it has, the ON TIMER statement is executed.

TIMER OFF disables the event trap. If an event takes place, it is not remembered if a subsequent TIMER ON is used.

TIMER STOP disables the event trap, but if an event occurs, it is remembered and an ON TIMER statement will be executed as soon as trapping is enabled.

Also see ON TIMER Statement.

TRON/TROFF Statements/Commands

Syntax: TRON

TROFF

Purpose: To trace the execution of program statements.

Remarks: As an aid in debugging, the TRON statement may be executed in either direct or indirect mode. With TRON in operation, each line number of the program is printed on the screen as it is executed.

The numbers appear enclosed in square brackets. The trace flag is disabled with the TROFF statement (or when a NEW command is executed).

Example: TRON

```
10 K=10
20 FOR J=1 TO 2
30      L=K + 10
40      PRINT J;K;L
50      K =K + 10
60 NEXT J
70 END
```

will yield

```
[10] [20] [30] [40] 1  10  20
[50] [60] [30] [40] 2  20  30
[50] [60] [70]
```

USR Function

Syntax: USR [<*digit*>] [(<*argument*>)]

where <*digit*> specifies which USR routine is being called. See the DEF USR statement, for rules governing <*digit*>. If <*digit*> is omitted, USR0 is assumed.

<*argument*> is the value passed to the subroutine It may be any numeric or string expression.

Purpose: To call an assembly language subroutine.

Remarks: If a segment other than the default segment (data segment) is to be used, a DEF SEG statement must be executed prior to a USR function call. The address given in the DEF SEG statement determines the segment address of the subroutine.

For each USR function, a corresponding DEF USR statement must be executed to define the USR call offset, This offset and the currently active DEF SEG segment address determine the starting address of the subroutine.

Example:

```
100 DEF SEG = &H8000
110 DEF USR0 = 0
120 X = 5
130 Y = USR0 (X)
140 PRINT Y
```

The type (numeric or string) of the variable receiving the value must be consistent with the argument passed. This setup of the string space differs from that of the interpreter.

VAL Function

Syntax: VAL (<*string*>)

<*string*> must be a numeric character stored as a string.

Purpose: To return the numeric value of string <*string*>. The VAL function also strips leading blanks, tabs, and linefeeds from the argument string. For example,

```
VAL("-3")
```

returns -3.

Example 1:

```
10 READ NAME$,CITY$, STATE$,ZIP$
20 IF VAL(ZIP$)<90000 OR VAL(ZIP$)>96699
THEN PRINT NAME$ TAB(25) "OUT OF
STATE"
30 IF VAL(ZIP$)>=90801 AND
VAL(ZIP$)<=90815 THEN PRINT NAME$
TAB(25) "LONG BEACH"
.
.
.
```

See the STR$ function, for details on numeric-to-string conversion.

Example 2:

```
10 A=VAL ("1234ABCD")
20 PRINT A
```

will yield

```
1234
```

VARPTR Function

Syntax 1: VARPTR (<*variable name*>)

Syntax 2: VARPTR (# <*file number*>)

Purpose: Syntax 1

Returns the address of the first byte of data identified with <*variable name*>. The variable must have been defined prior to the execution of the VARPTR function. Otherwise an "Illegal function call" error results. Variables are defined by executing any reference to the variable.

Any type variable name may be used (numeric, string, array). For string variables, the address of the first byte of the string descriptor is returned (see "Assembly Language Subroutines," Section 6.1 for discussion of the string descriptor). The address returned will be an integer in the range 32767 to −32768. If a negative address is returned, add it to 65536 to obtain the actual address.

VARPTR is usually used to obtain the address of a variable or array so that it may be passed to an assembly language subroutine. A function call of the form VARPTR(A(0)) is usually specified when passing an array, so that the lowest-addressed element of the array is returned.

Note: All simple variables should be assigned before calling VARPTR for an array, because the addresses of the arrays change whenever a new simple variable is assigned.

Syntax 2

For sequential files, returns the starting address of the disk I/O buffer assigned to <*file number*>. For random files, returns the address of the FIELD buffer assigned to <*file number*>.

Example:

```
100 X = USR(VARPTR(Y))
```

VARPTR$ Function

Syntax: VARPTR$ (<*variable name*>)

where <*variable name*> is the name of a variable in the program.

Purpose: To return a character form of the memory address of the variable in a form that is compatible for programs that may later be compiled.

Remarks: VARPTR$ is primarily used to execute substrings with the DRAW and PLAY statements in programs that will later be compiled. With programs that will not be later compiled, the standard syntax of the PLAY and DRAW statements will be sufficient to produce desired effects.

The variable must have been defined prior to the execution of the VARPTR function. Otherwise an "Illegal function call" error results. Variables are defined by executing any reference to the variable.

VARPTR$ returns a three-byte string in the form:

byte 0 = type
byte 1 = low byte of address
byte 2 = high byte of address

Note, however, that the individual parts of the string are not considered characters.

Note: Because array addresses, string addresses and file data block change whenever a new variable is assigned, it is unsafe to save the result of a VARPTR function in a variable. It is recommended that VARPTR is executed before each use of the result.

Example:

```
10 PLAY "X" + VARPTR$(A$)
```

Uses the subcommand X (execute), plus the contents of A$, as the string expression in the PLAY statement.

VIEW Statement

Syntax: VIEW [[SCREEN] [(*Vx1, Vy1*)–(*Vx2, Vy2*)
[,[<*color*>] [,[<*border*>]]]]]

Purpose: To define screen limits for graphics activity.

Remarks: VIEW defines a "Physical Viewport" limit from *Vx1, Vy1* (upper left x,y coordinates) to *Vx2, Vy2* (lower right x,y coordinates). The x and y coordinates must be within the physical bounds of the screen. The physical viewport defines the rectangle within the screen into which graphics may be mapped.

RUN, and RUN, SCREEN and VIEW with no arguments, define the entire screen as the viewport.

The <*color*> attribute allows the user to fill the view area with a color. If color is omitted, the view area is not filled.

The <*border*> attribute allows the user to draw a line surrounding the viewport if space for a border is available. If border is omitted, no border is drawn.

The [SCREEN] option dictates that the x and y coordinates are absolute to the screen, not relative to the border of the physical viewport, and only graphics within the viewport will be plotted.

Examples: For the form: VIEW (*Vx1, Vy1*)–(*Vx2, Vy2*)

all points plotted are relative to the viewport. That is, *Vx1* and *Vy1* are added to the x and y coordinates before putting the point down on the screen.

If: **VIEW (10,10)–(200,100)**

were executed, then the point set down by the statement PSET (0,0),3 would actually be at the physical screen location 10,10.

For the form: VIEW SCREEN (*Vx1, Vy1*)–(*Vx2, Vy2*)

all coordinates are screen absolute rather than viewport relative.

If: **VIEW SCREEN (10,10)– (200,100)**

were executed, then the point set down by the statement PSET (0,0),3 would actually not appear because 0,0 is outside of the Viewport. PSET (10,10),3 is within the Viewport, and places the point in the upper-left hand corner of the viewport.

A number of VIEW statements may be executed. If the newly described viewport in not wholly within the previous viewport, the screen can be reinitialized with the VIEW statement. Then the new viewport may be stated. If the new viewport is entirely within the previous one, as in the following example, the intermediate VIEW statement, is not necessary. This example opens three viewports, each smaller than the previous one. In each case, a line that is defined to go beyond the borders is programmed, but appears only within the viewport border.

```
260 CLS
280 VIEW: REM ** Make the viewport the entire
screen.
300 VIEW (10,10)-(300,180),,1
320     CLS
340     LINE (0,0)-(310,190),1
360     LOCATE 1,11:PRINT "A big viewport"
380 VIEW SCREEN (50,50)-(250,150),,1
400     CLS:REM**Note, CLS clears only viewport
420     LINE (300,0)-(0,199),1
440     LOCATE 9,9: PRINT "A medium
        viewport"
460 VIEW SCREEN (80,80)-(200,125),,1
480     CLS
500     CIRCLE (150,100),20,1
520     LOCATE 11,9: PRINT "A small
        viewport"
```

VIEW PRINT Statement

Syntax: VIEW PRINT [<*top screen line*> TO <*bottom screen line*>]

Purpose: To set the boundaries of the screen text window.

Remarks: VIEW PRINT without top and bottom line parameters initializes the whole screen area as the text window.

Statements and functions which operate within the defined text window include LOCATE PRINT and SCREEN.

The Screen Editor will limit functions such as scroll and cursor movement to the text window.

Also see the VIEW Statement.

WAIT Statement

Syntax: WAIT <*port number*>,*i*[,*j*]

where *i* and *j* are integer expressions.

Purpose: To suspend program execution while monitoring the status of a machine input port.

Remarks: The WAIT statement causes execution to be suspended until a specified machine input port develops a specified bit pattern. The data read at the port is exclusive OR'ed with the integer expression *j*, and then AND'ed with *i*. If the result is zero, Microsoft GW-BASIC loops back and reads the data at the port again. If the result is nonzero, execution continues with the next statement. If *j* is omitted, it is assumed to be zero.

Warning: It is possible to enter an infinite loop with the WAIT statement, in which case it will be necessary to manually restart the machine. To avoid this, WAIT must have the specified value at <*port number*> during some point in the program execution.

Example:

```
100 WAIT 32,2
```

WHILE...WEND Statement

Syntax: WHILE *<expression>*

.
[*<loop statements>*]
.

.
WEND

Purpose: To execute a series of statements in a loop as long as a given condition is true.

Remarks: If *<expression>* is not zero (i.e., true), *<loop statements>* are executed until the WEND statement is encountered. Microsoft GW-BASIC then returns to the WHILE statement and checks *<expression>*. If it is still true, the process is repeated. If it is not true, execution resumes with the statement following the WEND statement.

WHILE/WEND loops may be nested to any level. Each WEND will match the most recent WHILE. An unmatched WHILE statement causes a "WHILE without WEND" error, and an unmatched WEND statement causes a "WEND without WHILE" error.

Example:

```
90 'BUBBLE SORT ARRAY A$ WHICH HAS J ELEMENTS.
100 FLIPS=1 'FORCE ONE PASS THRU LOOP
110 WHILE FLIPS
115     FLIPS=0
120     FOR I=1 TO J-1
130     IF A$(I)>A$(I+1) THEN SWAP A$(I), A$(I+1):FLIPS=1
140     NEXT I
150 WEND
```

Note: Do not direct program flow into a WHILE/WEND loop without entering through the WHILE statement.

WIDTH Statement

Syntax 1: WIDTH [LPRINT]<*size*>

Syntax 2: WIDTH <*file number*>,<*size*>

Syntax 3: WIDTH <*device*>,<*size*>

<*size*> is a numeric expression in the range 0 to 255. It specifies the width of the printed line.

<*file number*> is a numeric expression in the range 1 to 15. This is the number of the file that is open.

<*device*> is a string expression indicating the device that is to be used.

Purpose: To set the printed line width in number of characters for the screen or line printer.

Remarks: Syntax 1: If the LPRINT option is omitted, the line width is set at the screen. If LPRINT is included, the line width is set at the line printer.

The WIDTH statement may cause the screen to be cleared.

When specifying WIDTH <*size*> or WIDTH "SCRN:", <*size*> (i.e. sets the screen width), only 40 or 80 column width is allowed.

In specifying WIDTH LPRINT <*size*> or WIDTH "LPT:", <*size*> (i.e. sets the line printer width), if <*size*> is 255, the line width is "infinite"; that is, GW-BASIC never inserts a carriage return. However, the position of the cursor or the print head, as given by LPOS function, returns to zero after position 255.

Syntax 2: With Syntax 2, if the file for the specified device is open, the width is immediately changed to the specified size. This allows the width to be changed while the file is open.

Syntax 3: With Syntax 3, the default line width for the specified device is set to <*size*>. The line widths of currently open files are not modified. A subsequent OPEN <*filespec*> FOR OUTPUT AS #n will use the specified value for the width initially.

Example:

```
20 OPEN "LPT1:"FOR OUTPUT AS #1
30 PRINT #1, "12345678890"
35 PRINT #1
40 WIDTH #1, 6
50 PRINT #1, "1234567890"
RUN
```

will yield on the printer

```
12345
67890

123456
7890
```

WINDOW Statement

Syntax: WINDOW [[SCREEN] (*Wx1, Wy1*)–(*Wx2, Wy2*)]

where:

(*Wx1, Wy1*)–(*Wx2, Wy2*) are the world coordinates specified by the programmer to define the coordinates of the lower left and upper right screen border.

SCREEN inverts the y axis of the world coordinates so that screen coordinates coincide with the traditional Cartesian arrangement: x increases left to right, and y decreases top to bottom.

Purpose: To define the logical dimensions of the current viewport.

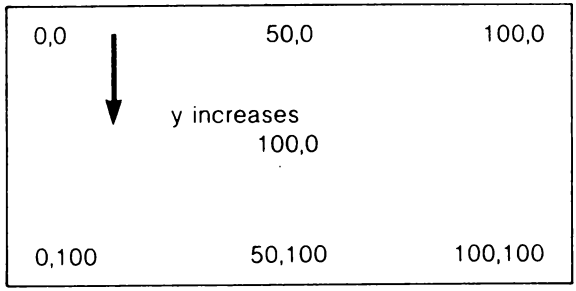
Remarks: WINDOW allows the user to redefine the screen border coordinates.

WINDOW allows the user to draw lines, graphs, or objects in space not bounded by the physical dimensions of the screen. This is done by using programmer-defined coordinates called "World coordinates". When the programmer has redefined the screen, graphics can be drawn within a customized mapping system.

BASIC converts world coordinates into physical coordinates for subsequent display within the current viewport. To make this transformation from world space to the physical space of the viewing surface (screen), one must know what portion of the (floating point) world coordinate space contains the information to be displayed. This rectangular region in world coordinate space is called a Window. RUN, or WINDOW with no arguments, disables "Window" transformation.

The WINDOW SCREEN variant inverts the normal Cartesian direction of the y coordinate. Consider the following:

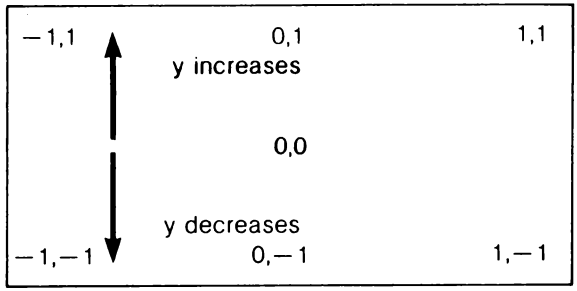
In the default, a section of the screen appears as:



now execute:

WINDOW (−1,−1)−(1,1)

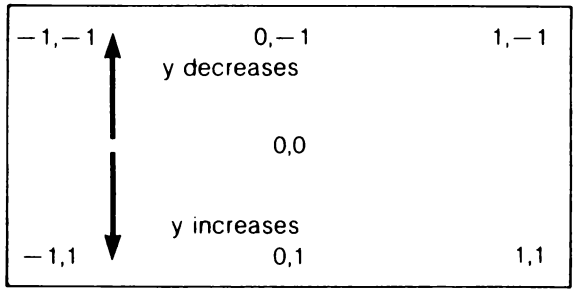
and the screen appears as:



If the variant:

WINDOW SCREEN (−1,−1)−(1,1)

is executed then the screen appears as:



The following example illustrates two lines with the same endpoint coordinates. The first is drawn on the default screen, and the second is on a redefined window.

```
200 LINE (100,100) − (150,150), 1
220 LOCATE 2,20:PRINT "The line on the default
screen"
240 WINDOW SCREEN (100,100) − (200,200)
260 LINE (100,100) − (150,150),1
280 LOCATE 8,18:PRINT"& the same line on a
redefined window"
```

WRITE Statement

Syntax: WRITE [<*list of expressions*>]

Purpose: To output data to the screen.

Remarks: If <*list of expressions*> is omitted, a blank line is output. If <*list of expressions*> is included, the values of the expressions are output to the screen. The expressions in the list may be numeric and/or string expressions. They must be separated by commas.

When the printed items are output, each item is separated from the last by a comma. Printed strings are delimited by quotation marks. After the last item in the list is printed, GW-BASIC inserts a carriage return/linefeed.

WRITE outputs numeric values using the same format as the PRINT statement.

Example:

```
10 A = 80:B = 90:C$ = "THAT'S ALL"
20 WRITE A,B,C$
```

will yield

```
80, 90,"THAT'S ALL"
```

WRITE # Statement

Syntax: WRITE # <*file number*>,<*list of expressions*>

Purpose: To write data to sequential file.

Remarks: <*file number*> is the number under which the file was OPENed in "O" mode (see "OPEN Statement"). The expressions in the list are string or numeric expressions. They must be separeted by commas.

The difference between WRITE # and PRINT # is that WRITE # inserts commas between the items as they are written to the file and delimits strings with quotation marks. Therefore, it is not necessary for the user to put explicit delimiters in the list. A carriage return/linefeed sequence is inserted after the last item in the list is written to the file.

Example: Let A$ = "CAMERA" and B$ = "93604 – 1"

The statement:

```
WRITE #1,A$,B$
```

writes the following image to disk:

```
"CAMERA","93604 – 1"
```

A subsequent INPUT # statement, such as

```
INPUT #1,A$,B$
```

would input "CAMERA"to A$ and "93604 – 1" to B$.

APPENDICES

A Error Codes and Error Messages

B Microsoft GW-BASIC Reserved Words

C Mathematical Function Not Intrinsic to GW-BASIC 3.1

D Character Code Table

APPENDIX A
ERROR CODES AND ERROR MESSAGES

Number **Message**

1 NEXT without FOR

A variable in a NEXT statement does not correspond to any previously executed, unmatched FOR statement variable.

2 Syntax error

A line is encountered that contains some incorrect sequence of characters (such as an unmatched parenthesis, misspelled command or statement, incorrect punctuation, etc.).

With GW-BASIC, the incorrect line will be part of a DATA statement.

Microsoft GW-BASIC Interpreter automatically enters edit mode at the line that caused the error.

3 Return without GOSUB

A RETURN statement is encountered for which there is no previous, unmatched GOSUB statement.

4 Out of data

A READ statement is executed when there are no DATA statements with unread data remaining in the program.

5 Illegal function call

A parameter that is out of range is passed to a math or string function. An FC error may also occur as the result of:

1. A negative or unreasonably large subscript.

2. A negative of zero argument with LOG.

3. A negative argument to SQR.

4. A negative mantissa with a noninteger exponent.

5. A call to a USR function for which the starting address has not yet been given.

6. An improper argument to MID$, LEFT$, RIGHT$, INP, OUT, WAIT, PEEK, POKE, TAB, SPC, STRING$, SPACE$, INSTR, or ON... GOTO.

7. A negative record number used with GET or PUT.

6 Overflow

The result of a calculation is too large to be represented in Microsoft GW-BASIC number format. If underflow occurs, the result is zero and execution continues without an error.

7 Out of memory

A program is too large, or has too many FOR loops or GOSUBs, too many variables, or expressions that are too complicated for a file buffer to be allocated.

8 Undefined line number

A nonexistent line is referenced in a GOTO, GOSUB, IF...THEN... ELSE, or DELETE statement.

9 Subscript out of range

An array element is referenced either with a subscript that is outside the dimensions of the array or with the wrong number of subscripts.

10 Duplicate definition

Two DIM statements are given for the same array; or, a DIM statement is given for an array after the default dimension of 10 has been established for that array.

11 Division by zero

A division by zero is encountered in an expression; or, the operation of involution results in zero being raised to a negative power. Machine infinity with the sign of the numerator is supplied as the result of the division, or positive machine infinity is supplied as the result of involution, and execution continues.

12 Illegal direct

A statement that is illegal in direct mode is entered as a direct mode command.

13 Type mismatch

A string variable name is assigned a numeric value or vice versa; a function that expects a numeric argument is given a string argument or vice versa.

14 Out of string space

String variables have caused BASIC to exceed the amount of free memory remaining. Microsoft GW-BASIC will allocate string space dynamically, until it runs out of memory.

15 String too long

An attempt is made to create a string more than 255 characters long.

16 String formula too complex

A string expression is too long or too complex. The expression should be broken into smaller expressions.

17 Can't continue

An attempt is made to continue a program that:

1. Has halted due to an error.
2. Has been modified during a break in execution.
3. Dose not exist.

18 Undefined user function

A USR function is called before the function definition (DEF statement) is given.

19 No RESUME

An error handling routine is entered but contains no RESUME statement.

20 RESUME without error

A RESUME statement is encountered before an error handling routine is entered.

21 Unprintable error

An error message is not available for the error condition that exists.

22 Missing operand

An expression contains an operator with no operand following it.

23 Line buffer overflow

An attempt has been made to input a line that has too many characters.

24 Device timeout

The device you have specified is not available at this time

25 Device fault

An incorrect device designation has been entered.

26 FOR without NEXT

A FOR statement was encountered without a matching NEXT.

27 Out of paper

The printer device is out of paper.

28 Unprintable error

An error message is not available for the condition which exists.

29 WHILE without WEND

A WHILE statement does not have a matching WEND.

30 WEND without WHILE

A WEND statement was encountered without a matching WHILE.

31-49 Unprintable error

An error message is not available for the condition which exists.

Disk Errors

50 Field overflow

A FIELD statement is attempting to allocate more bytes than were specified for the record length of a random file.

51 Internal error

An internal malfunction has occurred in Microsoft GW-BASIC.

52 Bad file number

A statement or command references a file with a file number that is not OPEN or is out of the range of file numbers specified at initialization.

53 File not found

A LOAD, KILL, NAME, or OPEN statement/command references a file that does not exist on the current disk.

54 Bad file mode

An attempt is made to use PUT, GET, or LOF with a sequential file, to LOAD a random file, or to execute an OPEN statement with a file mode other than I, O, or R.

55 File already open

A sequential output mode OPEN statement is issued for a file that is already open; or a KILL statement is given for a file that is open.

56 Unprintable error

An error message is not available for the condition that exists.

57 Device I/O error

An I/O error occurred on a disk I/O operation. It is a fatal error; i.e., the operating system cannot recover from the error.

58 File already exists

The filename specified in a NAME statement is identical to a filename already in use on the disk.

59-60 Unprintable error

An error message is not available for the condition that exists.

61 Disk full

All disk storage space is in use.

62 Input past end

An INPUT statement is executed after all the data in the file has been INPUT, or for a null (empty) file. To avoid this error, use the EOF function to detect the end-of-file.

63 Bad record number

In a PUT or GET statement, the record number is either greater than the maximum allowed (32,767) or equal to zero.

64 Bad file name

An illegal form is used for the filename with a LOAD, SAVE, KILL, or OPEN statement (e.g., a filename with too many characters).

65 Unprintable error

An error message is not available for the condition that exists.

66 Direct statement in file

A direct statement is encountered while LOADing an ASCII-format file. The LOAD is terminated.

67 Too many files

An attempt is made to create a new file (using SAVE or OPEN) when all 255 directory entries are full.

68 Device Unavailable

The device that has been specified is not available at this time.

69 Communications buffer overflow

Not enough space has been reserved for communications I/O.

70 Permission Denied

The disk has a write protect tab intact, or is a disk that cannot be written to.

71 Disk not ready

Could be caused by a number of problems. The most likely is that the disk is not inserted properly.

72 Disk media error

A hardware or disk problem occurred while the disk was being written to or read from. For example, the disk may be damaged or the disk drive may not be working properly.

74 Rename across disks

An attempt was made to rename a file with a new drive designation. This is not allowed.

75 Path/file access error

During an OPEN, MKDIR, CHDIR, or RMDIR operation, MS-DOS was unable to make a correct Path to File name connection. The operation is not completed.

76 Path not Found

During an OPEN, MKDIR, CHDIR, or RMDIR operation, MS-DOS was unable to find the path specified. The operation is not completed.

** You cannot SHELL to BASIC

No error number. During initialization, BASIC discovers that it is being run as a Child. BASIC is not run and control returns to the Parent copy of BASIC.

** Can't continue after SHELL

No error number. Upon returning from a Child process, the SHELL statement discovers that there is not enough memory for BASIC to continue. BASIC closes any open files and exits to MS-DOS.

APPENDIX B
MICROSOFT GW-BASIC
RESERVED WORDS

The following is a list of reserved words used in Microsoft GW-BASIC 3.1.

ABS
AND
ASC
ATN
AUTO

BEEP
BLOAD
BSAVE

CALL
CALLS
CDBL
CHAIN
CHDIR
CHR$
CINT
CIRCLE
CLEAR
CLOSE
CLS
COLOR
COM
COMMON
CONT
COS
CSNG
CSRLIN
CVD
CVI
CVS

DATA
DATE$
DEF FN
DEFDBL
DEFINT
DEFSEG
DEFSTR
DEF USR
DELETE
DIM
DRAW

EDIT
ELSE
END
ENVIRON
ENVIRON$
EOF
ERASE
ERDEV
ERDEV$
ERL
ERR
ERROR
EXP

FIELD
FILES
FIX
FOR
FRE

GET
GO TO
GOSUB

HEX$

IF
IMP
INKEY$
INP
INPUT
INPUT #
INPUT$
INSTR
INT
IOCTL
IOCTL$

KEY
KILL

LCOPY
LEFT$
LEN
LET
LINE
LIST
LLIST
LOAD
LOC
LOCATE

LOCK
LOF
LOG
LPOS
LPRINT
LSET

MERGE
MID$
MKD$
MKDIR
MKI$
MKS$
MOD
MOTOR

NAME
NEW
NEXT
NOT

OCT$
ON
OPEN
OPTION
OR

PAINT
PALETTE
PALETTE USING
PEEK
PEN
PLAY
PMAP
POINT
POKE
POS
PRESET
PRINT
PRINT# USING
PSET
PUT

RANDOMIZE
READ
REM
RENUM
RESET
RESTORE
RESUME
RETURN
RIGHT$
RMDIR
RND
RSET
RUN

SAVE
SCREEN
SGN
SHELL
SIN
SOUND
SPACE$
SPC
SQR
STICK
STOP
STR$
STRIG
STRING$
SWAP
SYSTEM

TAB
TAN
THEN
TIME$
TIMER
TO
TROFF
TRON

UNLOCK
USING
USR

VAL
VARPTR
VARPTR$
VIEW

WAIT
WEND
WHILE
WIDTH
WINDOW
WRITE
WRITE$

XOR

APPENDIX C
MATHEMATICAL FUNCTIONS NOT INTRINSIC TO GW-BASIC 3.1

Derived Functions

Functions that are not intrinsic to Microsoft GW-BASIC may be calculated as follows.

Function	Microsoft GW-BASIC Equivalent
SECANT	SEC(X) = 1/COS(X)
COSECANT	CSC(X) = 1/SIN(X)
COTANGENT	COT(X) = 1/TAN(X)
INVERSE SINE	ARCSIN(X) = ATN(X/SQR (−X*X + 1))
INVERSE COSINE	ARCCOS(X) = −ATN(X/SQR (−X*X + 1)) + 1.5708
INVERSE SECANT	ARCSEC(X) = ATN(X/SQR (X*X − 1)) + SGN(SGN(X) − 1)*1.5708
INVERSE COSECANT	ARCCSC(X) = ATN(X/SQR (X*X − 1)) + (SGN(X) − 1)*1.5708
INVERSE COTANGENT	ARCCOT(X) = ATN(X) + 1.5708
HYPERBOLIC SINE	SINH(X) = (EXP(X) − EXP (−X))/2
HYPERBOLIC COSINE	COSH(X) = (EXP(X) + EXP (−X))/2
HYPERBOLIC TANGENT	TANH(X) = (EXP(X) − EXP (−X))/(EXP(X) + EXP(−X))
HYPERBOLIC SECANT	SECH(X) = 2/(EXP(X) + EXP (−X))

HYPERBOLIC COSECANT	CSCH(X) = 2/(EXP(X) – EXP (–X))
HYPERBOLIC COTANGENT	COTH(X) = (EXP(X) + EXP (–X))/ (EXP(X) – EXP(–X))
INVERSE HYPERBOLIC SINE	ARCSINH(X) = LOG(X + SQR (X*X + 1))
INVERSE HYPERBOLIC COSINE	ARCCOSH(X) = LOG(X + SQR (X*X – 1))
INVERSE HYPERBOLIC TANGENT	ARCTANH(X) = LOG((1 + X)/ (1 – X))/2
INVERSE HYPERBOLIC SECANT	ARCSECH(X) = LOG((SQR (–X*X + 1) + 1)/X)
INVERSE HYPERBOLIC COSECANT	ARCCSCH(X) = LOG((SGN (X)*SQR(X*X + 1) + 1)/X)
INVERSE HYPERBOLIC COTANGENT	ARCCOTH(X) = LOG((X + 1)/ (X – 1))/2

Appendix D
Character Code Table

Decimal	Hexadecimal	Character	Decimal	Hexadecimal	Character
0	00	BLANK (NULL)	36	24	$
1	01	☺	37	25	%
2	02	●	38	26	&
3	03	♥	39	27	'
4	04	◆	40	28	(
5	05	♣	41	29	)
6	06	♠	42	2A	*
7	07		43	2B	+
8	08	◘	44	2C	,
9	09		45	2D	-
10	0A		46	2E	.
11	0B		47	2F	/
12	0C		48	30	0
13	0D		49	31	1
14	0E	♫	50	32	2
15	0F	☼	51	33	3
16	10	►	52	34	4
17	11	◄	53	35	5
18	12	↕	54	36	6
19	13	‼	55	37	7
20	14	¶	56	38	8
21	15	§	57	39	9
22	16	▬	58	3A	:
23	17	↨	59	3B	;
24	18	↑	60	3C	<
25	19	↓	61	3D	=
26	1A	→	62	3E	>
27	1B	←	63	3F	?
28	1C		64	40	@
29	1D		65	41	A
30	1E		66	42	B
31	1F		67	43	C
32	20	BLANK (SPACE)	68	44	D
33	21	!	69	45	E
34	22	"	70	46	F
35	23	#	71	47	G

Decimal	Hexadecimal	Character	Decimal	Hexadecimal	Character
72	48	H	108	6C	l
73	49	I	109	6D	m
74	4A	J	110	6E	n
75	4B	K	111	6F	o
76	4C	L	112	70	p
77	4D	M	113	71	q
78	4E	N	114	72	r
79	4F	O	115	73	s
80	50	P	116	74	t
81	51	Q	117	75	u
82	52	R	118	76	v
83	53	S	119	77	w
84	54	T	120	78	x
85	55	U	121	79	y
86	56	V	122	7A	z
87	57	W	123	7B	{
88	58	X	124	7C	¦
89	59	Y	125	7D	}
90	5A	Z	126	7E	~
91	5B	[	127	7F	△
92	5C		128	80	Ç
93	5D	]	129	81	ü
94	5E	^	130	82	é
95	5F		131	83	â
96	60	`	132	84	ä
97	61	a	133	85	à
98	62	b	134	86	á
99	63	c	135	87	ç
100	64	d	136	88	ê
101	65	e	137	89	ë
102	66	f	138	8A	è
103	67	g	139	8B	ï
104	68	h	140	8C	î
105	69	i	141	8D	ì
106	6A	j	142	8E	Ä
107	6B	k	143	8F	A

Decimal	Hexadecimal	Character	Decimal	Hexadecimal	Character
144	90	É	180	B4	
145	91	æ	181	B5	
146	92	Æ	182	B6	
147	93	ô	183	B7	
148	94	ö	184	B8	
149	95	ò	185	B9	
150	96	û	186	BA	
151	97	ù	187	BB	
152	98	ÿ	188	BC	
153	99	Ö	189	BD	
154	9A	Ü	190	BE	
155	9B	¢	191	BF	
156	9C	£	192	C0	
157	9D	¥	193	C1	
158	9E	Pt	194	C2	
159	9F	ƒ	195	C3	
160	A0	á	196	C4	
161	A1	í	197	C5	
162	A2	ó	198	C6	
163	A3	ú	199	C7	
164	A4	ñ	200	C8	
165	A5	Ñ	201	C9	
166	A6	ª	202	CA	
167	A7	º	203	CB	
168	A8	¿	204	CC	
169	A9	⌐	205	CD	
170	AA	¬	206	CE	
171	AB	½	207	CF	
172	AC	¼	208	D0	
173	AD	¡	209	D1	
174	AE	<<	210	D2	
175	AF	>>	211	D3	
176	B0	▒	212	D4	
177	B1	▒	213	D5	
178	B2	▓	214	D6	
179	B3	┤	215	D7	

Decimal	Hexadecimal	Character
216	D8	⊞
217	D9	◰
218	DA	◲
219	DB	■
220	DC	▄
221	DD	▌
222	DE	▐
223	DF	▀
224	E0	α
225	E1	β
226	E2	Γ
227	E3	π
228	E4	Σ
229	E5	σ
230	E6	μ
231	E7	τ
232	E8	Φ
233	E9	Θ
234	EA	Ω
235	EB	δ
236	EC	∞
237	ED	ϕ
238	EE	$\in$
239	EF	$\cap$
240	F0	$\equiv$
241	F1	$\pm$
242	F2	$\geq$
243	F3	$\leq$
244	F4	$\int$
245	F5	$\int$
246	F6	$\div$
247	F7	$\approx$
248	F8	°
249	F9	∙
250	FA	•
251	FB	$\sqrt{\ }$
252	FC	n
253	FD	2
254	FE	▮
255	FF	BLANK FF

INDEX

/M switch 2-1, 2-4

ABS function 7-1
Active page 2-6
Addition 3-9
AL register 6-8
ALL 7-12, 7-32
Animation 7-193
Arctangent 7-3
Array variables 3-8, 7-32, 7-48
Arrays 3-8, 7-59, 7-160
ASC function 7-2
ASCII
    codes 7-18
    format 7-126, 7-218
Assembly language subroutines 6-1, 7-10, 7-46, 7-246
    arguments passed to 6-6
    coding rules 6-5
    memory allocation 6-1
ATN function 7-3
AUTO command 2-6, 7-4

Background music 7-147, 7-173
BEEP statement 7-5
BLOAD command 7-6
BSAVE command 7-8

CALL statement 6-2, 7-10
CALLS statement 7-10
Carriage return 3-3, 7-87, 7-108, 7-109, 7-258, 7-263, 7-264
CDBL function 7-11
CHAIN statement 7-12, 7-32
Character set 3-1, D-1
Character code table D-1
CHDIR statement 7-16
CHR$ function 7-18
CINT function 7-19
CIRCLE statement 7-20
CLEAR statement 7-23
CLOSE statement 7-24
CLS statement 7-25

COLOR statement (Text mode) 7-26
COLOR statement (Graphic mode) 7-29
COM as event specifier 6-10
COM statement 7-31
COM trapping 6-10
Command level 2-5
COMMON statement 7-32
Concatenation 3-16
Constants
    numeric 3-4
    string 3-4
CONT command 7-33, 7-108
Continuation of a logical line 2-6
Control character editor 4-4
Control characters 3-3
COS function 7-34
CSNG function 7-35
CSRLIN function 7-36
CVD function 7-37
CVI function 7-37
CVS function 7-37

DATA statement 7-38, 7-203
DATE$ function 7-40
DATE$ statement 7-39
DEF FN statement 7-41
DEF SEG statement 6-3, 6-6, 7-45, 7-246
DEF USR statement 7-46, 7-246
Default device 5-1
DEFDBL statement 3-7, 7-43
DEFINT statement 3-7, 7-43
DEFSNG statement 3-7, 7-43
DEFSTR statement 3-7, 7-43
DELETE command 2-6, 7-47
Device status information 7-60
Device-independent I/O 5-1
DIM statement 7-48
Dir 7-224
Direct mode 2-5, 7-83, 7-137
Directories (hierarchical structure) 5-3
Display page 2-6
Division 3-10
Double precision 3-5, 7-11, 7-43, 7-184
DRAW statement 7-49

EDIT command 2-6, 7-54
Edit mode 7-54
Editor 4-1
END statement 7-54, 7-78
ENVIRON statement 7-55
ENVIRON$ function 7-57
Environment string table 7-55, 7-57
EOF function 7-58
ERASE statement 7-59
ERDEV function 7-60
ERDEV$ function 7-60
ERL function 7-61
ERR function 7-61
Error codes 7-61, 7-62, A-1
Error handling 7-61, 7-137, 7-211
Error messages A-1
ERROR statement/command 7-62
Error trapping 7-62
Escape 3-2
Evaluation of operators
    arithmetic 3-10
    logical 3-13
Event trapping 6-10
Exit 7-224
EXP function 7-64
Exponentiation 3-10, 3-11
Expressions 3-9

FIELD statement 7-65
Filenaming conventions 5-2
Files 5-8
    data 5-10
    protected 7-218
    protection 5-8
    random 7-65, 7-75, 7-100, 7-115, 7-125, 7-131, 7-152, 7-196
    random access 5-14
    sequential 5-10, 7-58, 7-89, 7-100, 7-109, 7-115, 7-152, 7-191, 7-264
FILES statement 7-68
FIX function 7-70
Floating-point accumulator (FAC) 6-9
FOR...NEXT statement 7-71
FRE function 7-74
Functions 3-19, 7-41

GET statement 7-65, 7-75, 7-76
Get statement
file i/o 7-75
graphics 7-76
GOSUB statement 7-78
GOTO statement 7-78, 7-80
Graphics 7-197
Graphics macro language 7-49

HEX$ function 7-81
Hexadecimal 3-5, 7-81

IF...GOTO statement 7-82
IF...THEN statement 7-61, 7-82
IF...THEN...ELSE statement 7-82
Indirect mode 2-5
INKEY$ function 7-85
INP function 7-86
INPUT statement 7-33, 7-65, 7-87
INPUT # statement 7-89
INPUT$ function 7-90
INSTR function 7-91
INT function 7-92
Integer 7-19, 7-70, 7-92
Integer division 3-10
Internal representation 6-2
Intrinsic functions 3-19
IOCTL statement 7-93
IOCTL$ function 7-94

KEY as event specifier 6-11
KEY statement 7-95
KEY trapping 6-11
KEY(n) statement 7-97
KILL statement 7-100

LEFT$ function 7-102
LEN function 7-103
LET statement 7-65, 7-104
Line continuation 2-6
Line format 2-6
LINE INPUT statement 7-108
LINE INPUT # statement 7-109
Line length 2-6
Line number generation 7-4

Line numbers 2-6, 7-207
Line printer 7-111, 7-124, 7-258
LINE statement 7-105
Line styling 7-105
Linefeed 2-6, 7-87, 7-108, 7-109, 7-263, 7-264
LIST command 2-6, 7-111
LLIST command 7-113
LOAD command 7-114, 7-218
LOC function 7-115
LOCATE statement 7-116
LOCK statement 7-118
LOF function 7-121
LOG function 7-122
Logical operators 3-13, 3-15
Loops 7-71, 7-257
LPOS function 7-123, 7-258
LPRINT statement 7-124
LPRINT option 7-258
LPRINT USING statement 7-124
LSET statement 7-125

Mathematical functions D-1
MERGE command 7-126
MID$ function 7-128
MID$ statement 7-127
MKD$ function 7-131
MKDIR statement 7-129
MKI$ function 7-131
MKS$ function 7-131
MOD operator 3-10
Modes of operation 2-5
Modulus arithmetic 3-10
Multiplication 3-10
Music background 7-147

NAME statement 7-132
Negation 3-10
NEW command 7-133
Numeric constants 3-4
Numeric variables 3-7

OCT$ function 7-134
Octal 3-5, 7-134
ON COM statement 7-135
ON ERROR GOTO statement 7-137

ON GOSUB in event trapping....6-12
ON GOSUB statement....7-138
ON GOTO statement....7-138
ON KEY statement....7-139
ON PEN statement....7-144
ON PLAY statement....7-146
ON STRIG statement....7-148
ON TIMER statement....7-150
OPEN statement....7-152
OPEN COM statement....7-157
Operators....3-9, 3-10, 3-11, 3-13
    string....3-16
OPTION BASE statement....7-160
Order of evaluation
    arithmetic operators....3-9
    logical operators....3-13
OUT statement....7-161
Overflow....3-12, 7-64, 7-240

PAINT statement....7-162
Parent directory shorthand notation....5-4
Pathing....5-2
Pathnames
    definition....5-2
    syntax of pathnames....5-3
PEEK function....7-165, 7-179
PEN as event specifier....6-11
PEN function....7-167
PEN OFF statement....7-166
PEN ON statement....7-166
PEN STOP statement....7-166
PEN trapping....6-11
PLAY function....7-173
PLAY OFF statement....7-174
PLAY ON statement....7-174
PLAY statement....7-169
PLAY STOP statement....7-174
PMAP function....7-175
POINT function....7-177
POKE statement....7-165, 7-179
POS function....7-180, 7-258
Precedence....3-9
    arithmetic operators....3-9

PRESET statement 7-181
PRINT statement 7-183
PRINT USING statement 7-186
PRINT # statement 7-191
PRINT # USING statement 7-191
Protected files 7-218
PSET statement 7-194
PUT statement 7-65, 7-196, 7-197

Random files 7-65, 7-75, 7-100, 7-115, 7-125, 7-131, 7-152, 7-196
Random numbers 7-201, 7-216
RANDOMIZE statement 7-201, 7-216
READ statement 7-203, 7-210
Relational operators 3-12
REM statement 7-205
RENUM command 7-12, 7-61, 7-207
Reserved words B-1
RESET command 7-209
RESTORE statement 7-210
RESUME statement 7-211
RETURN in event trapping 6-12
RETURN statement 7-78, 7-212
RIGHT$ function 7-213
RMDIR statement 7-214
RND function 7-201, 7-216
RSET statement 7-125
RUN command 7-217
RUN statement/command 7-217
Runtime error messages A-1

SAVE command 7-114, 7-218
SCREEN function 7-221
SCREEN statement 7-219
Sequential files 7-58, 7-89, 7-100, 7-109, 7-115, 7-152, 7-191, 7-264
SGN function 7-222
SHELL statement 7-223
Shell statement 5-21
Shorthand notation 5-4
SIN function 7-225
Single precision 3-5, 7-35, 7-43, 7-184
SOUND statement 7-226
Space requirements for variables 3-8

SPACE$ function 7-228
SPC function 7-229
Special characters 3-2
SQR function 7-230
STICK function 7-231
STOP statement 7-33, 7-54, 7-78, 7-232
STR$ function 7-233
STRIG as event specifier 6-11
STRIG function 7-234
STRIG statement 7-235
STRIG trapping 6-11
String
    descriptor 6-5
    literal 6-6, 6-9
String and numeric constants 3-4
String constants 3-4
String functions 7-37, 7-91, 7-102, 7-103, 7-127, 7-213, 7-233, 7-247
String operators 3-16
String variables 3-7, 7-43, 7-109
STRING$ function 7-236
Subroutines 7-10, 7-78, 7-138
Subscripts 3-8, 7-48, 7-160
Subtraction 3-10
SWAP statement 7-237
Switches 2-1
Syntax notation 1-3
Syntax of pathnames 5-3
SYSTEM command 7-238

Tab 3-2, 3-3
TAB function 7-239
TAN function 7-240
Tiling 7-163
TIME$ function 7-242
TIME$ statement 7-241
TIMER OFF statement 7-244
TIMER ON statement 7-244
TIMER STOP statement 7-244
TROFF statement/command 7-245
TRON statement/command 7-245
Type conversion 3-17

UNLOCK statement 7-118
USR function 6-7, 7-46, 7-246

VAL function 7-247
Values in AL register 6-8
Variables 3-8
    array 7-32, 7-48
    passing with COMMON 7-12
    string 7-43, 7-108, 7-109
VARPTR function 7-248
VARPTR$ function 7-250
VIEW PRINT statement 7-255
VIEW statement 7-252
Visual page 2-6

WAIT statement 7-256
WEND statement 7-257
WHILE statement 7-257
WIDTH LPRINT statement 7-258
WIDTH statement 7-258
WINDOW statement 7-260
Working directory shorthand notation 5-4
World coordinates 7-175, 7-260
WRITE statement 7-263
WRITE # statement 7-264